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ABSTRACT

This guide for industrial arts grades 7-9 provides teachers with a curriculum for the subject cluster of power/energy. An "Overview" section presents the rationale, discusses how the content of the program is related to the developmental stages of the adolescent, describes the structure of the industrial arts program, and lists program goals and objectives. The "Implementation" section covers program design, scope and sequence, time allotment, integration, selection of materials, evaluation, and students with special needs. The power/energy subject cluster has 3 areas of study and includes 13 core modules for electricity/electronics, 11 for power mechanics, and 11 for power/energy. Each module includes a major objective, estimated time, and student objectives with corresponding suggested activities and notes and suggested resources. Three modules common to all three areas are student orientation, safety, and careers. Module titles common to the three areas (although the modules themselves are different) are measurement, planning and design, consumerism, tools and fasteners, energy sources, and energy conversion. Other modules include components, energy transmission, transmission of power and energy, energy systems, power systems, electrical wiring, and routine care and maintenance. A bibliography is appended. (YLB)

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industrial arts 7-9

power/energy

electricity/electronics
power mechanics
power/energy

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These guides for the Industrial Arts 7-9 subject clusters (Construction, Graphic Communications, Power/Energy, and Manufacturing) replace the 1969 Industrial Arts Teacher's Guide for grades seven, eight and nine; and the interim guides for Construction, Graphic Communications, Power/Energy, and Manufacturing issued in 1976. They have been developed as part of the overall revision of the industrial arts programs for the junior nigh schools of Manitoba. They are based on recommendations included in the Report of the Home Economics and Industrial Arts Task Force of 1978 and Education for the Middle Years, a 1977 position paper of the Middle Years Program Review Committee, as well as suggestions from junior high school and community college teachers.

Industrial Arts 7-9: Construction, Graphic Communications, Power/Energy, and Manufacturing (1983) become the approved provincial guides for industrial arts in the junior high school, effective the fall of 1983.

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OVERVIEW

INTRODUCTION

The junior high school industrial arts curriculum has been revised to reflect the philosophy of the Middle Years Program Review Committee, and to provide objectives and learning experiences which will enable students to maximize their effectiveness as individuals within the family, business, and community. The focus is on the well-being of individuals, groups, and businesses/industries, the environmental qualities which affect that well-being, and on how individuals and industry in turn affect the environment.

The Middle Years Program Review Committee and the Home Economics and Industrial Arts Task Force have recommended that the curriculum:

1. de-emphasize sex bias in roles and expectations normally assigned to home economics and industrial arts programs;

2. minimize the sequencing of courses to enable students to participate in a wide variety of learning experiences, by providing an exploratory program, particularly at the introductory level.

A combined home economics/industrial arts exploratory program, at the introductory level, will be available.

The curriculum also reflects the effects of a rapidly changing society, awareness of many forms of industry and industrial processes, and social and technological changes which influence life styles and business/industry.

This guide should assist teachers in meeting students' physical, social, emotional, and intellectual needs through the emphases on the continuing responsibilities of individuals and groups, and on the processes by which decisions are made and action is taken. This guide provides student objectives, suggested activities, notes, and resources to assist teachers in planning programs related to their students and community.

RATIONALE

The study of industrial arts in the junior high school program in Manitoba is designed to help students clarify values, set personal goals, and acquire skills for improving the quality of life for individuals and groups in business, industry, community, and society.

Industrial arts has much to contribute to the growth and development of students in the middle years and to the curriculum of the middle years school. Industrial arts helps emerging and early adolescents in their search for identity and development of self-concept; encourages the development of such basic skills as learning how to learn and making decisions; encourages the development of skills in personal and family life and in business and industrial processes; explores possible career choices in industrial-arts related areas; and provides opportunities for students to discover new interests, growing capacities and the need for effective use and control of resources and technologies.

The study of industrial arts will enable students to:

1. Appreciate the interdependence of the individual, the family, and groups in business/industry and society, and understand the factors in society, business/industry, and the community which assist individuals in meeting basic needs.

2. Understand the influences which affect decision-making and realize that one can use natural and industrial resources effectively in making choices which are satisfying and accountable to self, family, groups, business/industry, and community.

3. Identify values and priorities in life and consider the quality of life as much as the quantity of production and consumption.

4. Understand the ways in which an individual, alone or as part of a group, can increase opportunities to achieve potential and satisfaction in life.

5. Appreciate good craftsmanship and design, both in the products of modern industry and in artifacts from past cultures.

6. Understand the necessity to adjust and adapt in a world of change.

7. Develop knowledge and skills to improve human relations and to meet present and future needs of society.

8. Appreciate the interdependence and the importance of practicing the management skills of planning, organizing, and controlling work.

9. Develop critical thinking related to materials, tools, and processes of industry, and creative expression related to industrial materials.

10. Recognize the importance of safety in the use and maintenance of tools, energy, equipment, and materials appropriate to various technologies in a productive society.

11. Develop positive attitudes towards safety, conservation, ecology, and technology.

12. Recognize consumer rights and responsibilities relating to self and to various types of industries.

13. Understand and recognize the vocations and general occupational characteristics of various types of industries.

14. Recognize the relationship of personal interests, abilities, preferences, and values to various career areas.

THE DEVELOPMENTAL STAGES OF ADOLESCENTS

The content of the industrial arts programs is closely related to adolescent developmental stages. The adolescent years are a period of transition, and within this period, students' development varies widely.

An outline of typical characteristics of junior high students has been used as a guide in creating, adapting, and suggesting learning experiences. Characteristics of adolescents may be described under the headings: cognitive, physical, emotional, social, and moral. All aspects of development are interconnected.

ADOLESCENT NEEDS	CHARACTERISTICS	APPROPRIATE ACTIVITIES
Cognitive: Develop intellectual activity which is logical and abstract, with thinking becoming more mobile, flexible and less egocentric.	Interested primarily in self, but gradually developing greater interest in the outside world and in family problems.	Begin with interests and concerns, then proceed to family, community and society. The 12-year-old is concerned with lack of resources. Begin with this problem and proceed to a discussion of family resources, then to resources in industries and in the community.
Physical: Develop one's physique and use the body effectively.	A physical age with tremendous variations.	Discuss the role of the individual, family, and business in meeting physical needs.
	Growth makes demands on energy.	Emphasize nutritious foods for growth and development required to learn and work effectively.
	Growth affects self-concept.	Encourage participation in projects to promote personal satisfaction and creativity.
	Concern with awkwardness and physical appearance.	Identify and discuss factors which affect personal appearance and safety in a work environment.
	Experience difficulty in carrying out long-range projects. May be restless with short attention span.	Provide variety in content and methods. Work on projects that can be completed in a short period of time or completed in sections. Encourage active participation in learning.

ADOLESCENT NEEDS	CHARACTERISTICS	APPROPRIATE ACTIVITIES
Emotional: Emotional needs are closely linked to physical needs.	Variable and intense.	Help students recognize that changes in their development affect behavior.
	Great stresses and contrasts.	
	Need to come to terms with emotions.	
	Inclined to be enthusiastic and often impulsive.	Create an atmosphere for tapping enthusiasm and impulse with techniques such as brainstorming, ad lib skits, word association, self-chosen projects and assignments.
Achieve emotional independence of parents and other adults.	Seeking identity.	Encourage students to identify individual strengths that lead to a greater understanding and acceptance of self.
Social: Desire and achieve socially responsible behavior.	Relationship with peers important.	Contrast activities and relationships with peers and family.
	Group oriented, but conflict between group and individuality.	Provide opportunities to work individually and in groups.
	Increasing maturity.	Help students to appreciate that each person is different physically and mentally, possessing characteristics which make one worthy of acceptance.
	Rise of sexuality and relationships with opposite sex.	

ADOLESCENT NEEDS	CHARACTERISTICS	APPROPRIATE ACTIVITIES
Moral: Acquire a set of values and an ethical system as a guide to behavior.	Live primarily in the present, now rather than tomorrow, but gradually growing more concerned with immediate and distant future. Social and intellectual development have important consequences for moral growth. Make personal evaluations. Begin to formulate own moral code. Less inclined to accept parental values. Begin to put self in another's place.	Build on present interests and concerns.

STRUCTURE OF THE PROGRAM

The Industrial Arts curriculum for grades seven, eight, and nine is divided into subject clusters, areas of study, and modules, rather than by grade designation. The division and the depth of content and objectives for each area of study in each grade level, will depend upon laboratories available, the time allotment, and the organization of the program in a school. Curriculum content proceeds from the establishment of basic understanding and skills at the introductory level, to a more intensive study and understanding at subsequent levels.

There are four subject clusters: Construction, Graphic Communications, Power/Energy, Manufacturing. Each subject cluster contains areas of study. Construction has one area of study: Construction; Graphic Communications has three areas of study: Drafting, Graphic Arts, Graphic Communications; Power/Energy has three areas of study: Electricity/Electronics, Power Mechanics, Power/Energy; and Manufacturing has four areas of study: Metalwork, Plastics, Woodwork, and Manufacturing. Each area of study is comprised of core modules (C) or core and optional (O)

modules. Three of the core modules, Student Orientation, Safety, and Careers, are common to all areas of study.

The subject cluster for Construction comprises 16 core and 5 optional modules.

Construction

I Student Orientation (C)
II Safety (C)
III Careers (C)
IV Measurement (C)
V Planning and Design (C)
VI Consumerism (C)
VII Site Selection (C)
VIII Materials (C)
IX Separation (C)
X Fastening (C)
XI Footings and Foundations (C)
XII Floors (C)
XIII Walls and Partitions (C)
XIV Roofs (C)
XV Enclosing (C)
XVI Energy and Insulation (C)
XVII Exterior Finish (O)
XVIII Interior Finish and Trim (O)
XIX Plumbing System (G)
XX Electricity (O)
XXI Landscaping (O)

The Graphic Communications subject cluster includes 13 core modules for Drafting, 14 core and 3 optional modules for Graphic Arts, and 19 core and 3 optional modules for Graphic Communications.

	Drafting	Graphic Arts	Graphic Communications
I	Student Orientation (C)	Student Orientation (C)	Student Orientation (C)
II	Safety (C)	Safety (C)	Safety (C)
III	Careers (C)	Careers (C)	Careers (C)
IV	Measurement (C)	Measurement (C)	Measurement (C)
V	Planning and Design (C)	Planning and Design (C)	Planning and Design (C)
VI	Consumerism (C)	Consumerism (C)	Consumerism (C)
VII	Sketching (C)	Design Concepts (C)	Sketching (C)
VIII	Mechanics of Drawing (C)	Screen Process (C)	Mechanics of Drawing (C)
IX	Pictorial Drawing (C)	Relief Printing (C)	Pictorial Drawing (C)
X	Orthographic Drawing (C)	Black and White Photography (C)	Orthographic Drawing (C)
XI	Drawing Interpretation (C)	Process Photography (C)	Drawing Interpretation (C)
XII	Drawing Reproduction (C)	Planographic Printing (C)	Design Concepts (C)
XIII	Electronic Systems (C)	Intaglio Printing (C)	Screen Process (C)
XIV		Packaging and Presentation (C)	Relief Printing (C)

	Drafting	Graphic Arts	Graphic Communications
XV		Color Photography (O)	Black and White Photography (C)
XVI		Office Graphic Arts Equipment (O)	Process Photography (C)
XVII		Electronic Systems (O)	Planographic Printing (C)
XVIII			Intaglio Printing (C)
XIX			Packaging and Presentation (C)
XX			Color Photography (O)
XXI			Office Graphic Arts Equipment (O)
XXII			Electronic Systems (O)

The Power/Energy subject cluster includes 13 core modules for Electricity/Electronics, 11 core modules for Power Mechanics, and 11 core modules for Power/Energy.

	Electricity/Electronics	Power Mechanics	Power/Energy
I	Student Orientation (C)	Student Orientation (C)	Student Orientation (C)
II	Safety (C)	Safety (C)	Safety (C)
III	Careers (C)	Careers (C)	Careers (C)
IV	Measurement (C)	Measurement (C)	Measurement (C)
V	Planning and Design (C)	Planning and Design (C)	Planning and Design (C)
VI	Consumerism (C)	Consumerism (C)	Consumerism (C)
VII	Components (C)	Tools and Fasteners (C)	Tools and Fasteners (C)
VIII	Tools and Fasteners (C)	Energy Sources (C)	Energy Sources (C)
IX	Energy Sources (C)	Energy Conversion (C)	Energy Conversion (C)
X	Energy Conversion (C)	Transmission of Power (C)	Transmission of Power and Energy (C)
XI	Energy Transmission (C)	Routine Care and Maintenance (C)	Power Systems (C)
XII	Energy Systems (C)		
XIII	Electrical Wiring (C)		

The Manufacturing subject cluster includes 15 core modules for Metalwork, 14 core modules for Plastics, 14 core modules for Woodwork, and 15 core modules for Manufacturing.

	Metalwork	Plastics	Woodwork	Manufacturing
I	Student Orientation (C)	Student Orientation (C)	Student Orientation (C)	Student Orientation (C)
II	Safety (C)	Safety (C)	Safety (C)	Safety (C)
III	Careers (C)	Careers (C)	Careers (C)	Careers (C)
IV	Measurement (C)	Measurement (C)	Measurement (C)	Measurement (C)
V	Design and Construction (C)	Design and Construction (C)	Design and Construction (C)	Design and Construction (C)
VI	Consumerism (C)	Consumerism (C)	Consumerism (C)	Consumerism (C)
VII	Materials (C)	Materials (C)	Materials (C)	Materials (C)
VIII	Separation (C)	Separation (C)	Separation (C)	Separation (C)
IX	Forming (C)	Forming (C)	Forming (C)	Forming (C)
X	Conditioning (C)	Fastening (C)	Fastening (C)	Conditioning (C)
XI	Fastening (C)	Finishing (C)	Finishing (C)	Fastening (C)
XII	Finishing (C)	Jigs and Fixtrues (C)	Jigs and Fixtures (C)	Finishing (C)
XIII	Jigs and Fixtures (C)	Mass Production (C)	Mass Production (C)	Jigs and Fixtures (C)
XIV	Mass Production (C)	Enterprise System (C)	Enterprise System (C)	Mass Production (C)
XV	Enterprise System (C)			Enterprise System (C)

Each of the modules for the 11 areas of study includes the following:

1. Major objectives accompany each module and provide an overview of what the student should achieve through the study of the module.

2. Student objectives are related to topics and are sequenced to lead to an understanding of the major objective. The objectives are based on students' needs and average abilities. Learning one objective leads to insight into how to proceed to the next objective, and, eventually, to the understanding of the major objective and the topics. If students are aware of the objectives, they may identify with them more closely and aim to achieve them.

3. Suggested activities and notes are designed to help students achieve objectives. These experiences help the students to acquire knowledge, learn skills, evaluate attitudes and values, and develop understanding, appreciation, and perception of topics and objectives. The learning experiences and activities should be added to and updated continually by the teacher and the students.

4. Resources are suggested to assist the teachers and the students in developing and understanding the topics, objectives, and learning experiences. The resources should be added to and updated continually by the teacher and the students.

PROGRAM GOALS

The general goals of the junior high industrial arts program are to assist students to:

- acquire an understanding of self.
- understand how personal, business, industrial, and societal needs are met through positive interrelationships.
- develop skills to meet needs in the home, in the community, and in business and industry.
- develop a high degree of safety consciousness.
- acquire basic skills in the use of common industrial tools, machines, and processes.
- become increasingly questioning, creative, and critical consumers of natural and industrial resources and accept responsibilities for decisions made.
- develop problem-solving and creative abilities involving materials, processes, and products of industry.
- become involved in energy-saving, ecology, conservation, and technological studies and activities.
- develop confidence, high standards of performance, and a sense of pride in achievement.
- discover and develop talents, aptitudes, interests, and potential in technical fields and applied sciences.
- acquire basic skills and knowledge related to materials and technical procedures.
- gain an insight into various types of industries and their relationship to individuals, communities, society, and economic systems and conditions.
- develop creative potential, both avocationally and vocationally.
- achieve a degree of competency that leads to further education, training, and employment.
- acquire an understanding of the relationship between technological advances, requirements of industry, careers, and economic conditions.
- develop skills to make choices leading toward the attainment of a better quality of life.

PROGRAM OBJECTIVES

The classification of educational objectives--psychomotor, affective, and cognitive--have a relationship to each other. Frequently, at least two, if not all three, types of learning occur simultaneously. The teacher may choose to concentrate on one objective at a time or to correlate two or more objectives. It is possible to incorporate all three types of objectives as components of behavior or action. The student may be developing a skill and at the same time acquiring an attitude or value as well as a knowledge of principles related to the skill.

MAJOR OBJECTIVES: ELECTRICITY/ELECTRONICS

This area of study is designed to aid beginning students to explore many facets of electricity and electronics, and to understand the relationship of these to self, society, safety, careers, consumerism, conservation, communications, industry, economics, and technology. Study in this area develops understanding, decision-making capabilities, and basic skills in the selection, use, and maintenance of relevant materials, tools, and components. Students apply knowledge, principles, and skills to techniques and processes related to design, diagram interpretation, assembly and testing procedures, and diagnosis of the products and services of electricity and electronics. Development of these can lead to present and future educational, vocational, avocational, and life skills, and to an appreciation of high standards of workmanship and the dignity of work.

The student should be able to:

- Explore and relate the significance of industrial arts to the needs of individuals, industry, and society.
- Develop safety consciousness and practice in the use of tools, machines, and processes through a wide range of exploratory experiences related to individuals and to production and servicing aspects of relevant hobbies and industries.
- Gain information about the general occupational characteristics of a variety of career fields and to match interests, abilities, likes, dislikes, and values to characteristics of various careers.
- Gain knowledge and skills related to imperial and SI metric sytems of measurement and to apply these to measurement activities and problems pertinent to electricity and electronics.
- Develop skills in and to understand the principles of planning and design, and to apply these skills and principles to electricity and electronics.
- Explore and relate the economic system and the economy to electricity/electronics and consumer awareness.
- Acquire knowledge about components and their importance, and to explore skills, techniques, and applications related to components by building and testing circuits, diagnosing and repairing malfunctions, and constructing electrical/electronic products and projects.
- Develop knowledge about and skill in the use of hand tools, power tools, meters, and fasteners, and to apply this knowledge and skill to electricity/electronics.
- Recognize the significance of energy sources in the development of civilizations, and to gain information about major and alternate sources of energy, the factors influencing their supply and use, and the need for energy conservation.
- Gain an understanding of the principles of energy conversion, to recognize the uses and relationships of the forms of energy, and to apply information about methods of producing electricity from other forms of energy to electricity/electronics projects and products.
- Obtain knowledge about energy transmission and various types of circuits, to recognize the relationship of input, control, transmission, output, and various devices to the transmission process, and to apply this process to communication devices.
- Gain knowledge of various types of energy systems and their uses, and to maintain and repair electrical/electronic systems.
- Recognize the significance of electrical transmission, circuits, materials, tools, Canadian and local electrical codes, electrical plans, schematic diagrams, and distribution of electricity to household electrical wiring, and to install outlets, lights, switches, and various types of household circuits.

MAJOR OBJECTIVES: POWER MECHANICS

This area of study is designed to aid beginning students to explore the science, knowledge, processes, and skills related to power mechanics, and to understand its relationship to self, society, careers, safety, consumerism, industry, economics, and technology. This study develops understanding, decision-making capabilities, and basic skills in the selection, use, and maintenance of materials, tools, and equipment, and in the techniques and processes related to design, production, and distribution of relevant products and services. Development of these can lead to present and future educational, vocational, avocational, and life skills, and to an appreciation of high standards of workmanship and the dignity of work.

The student should be able to:

- Explore and relate the significance of industrial arts the needs of individuals, industry, and society.
- Develop safety consciousness and practice in the

use of tools, machines, and processes through a wide range of exploratory experiences related to individuals and to production and servicing aspects of relevant hobbies and industries.
- Gain information about the general occupational characteristics of a variety of career fields and to match interests, abilities, likes, dislikes, and values to characteristics of various careers.
- Gain knowledge and skills related to imperial and SI systems of measurement and to apply these to measurement activities and problems pertinent to power mechanics.
- Develop skills in and to understand the principles of planning and design, and to apply these skills and principles to power mechanics.
- Explore and relate the economic system and the economy to power mechanics and consumer awareness.
- Develop knowledge about and skill in the use of hand tools, power tools, and fasteners, and to apply this knowledge and skill to power mechanics.
- Understand the significance of energy sources and to develop knowledge and skills related to the application of energy sources to fuel and ignition systems.
- Understand the application and influence of energy conversion processes in relation to basic engine design, two- and four-stroke cycle engines, other internal combustion engines, and cooling and lubrication systems.
- Explore the purposes and methods of power transmission and to gain knowledge and skills related to mechanical, fluid, and electrical power transmission.
- Recognize the significance of and to acquire knowledge and skills applicable to routine care and maintenance, basic tune-ups, and diagnostic procedures for small and automotive engines.

MAJOR OBJECTIVES: POWER/ENERGY

This area of study is designed to aid beginning students to explore the science, knowledge, processes, and skills related to power and energy, and to understand the relationship of power and energy to self, society, safety, careers, consumerism, conservation, industry, economics, technology, and to progress in standards of living in different nations. This study develops understanding, decision-making capabilities, and basic skills in the selection, use, and maintenance of materials, tools, components, and equipment. It provides opportunities to apply knowledge, principles, and skills to techniques and processes pertinent to planning and design, diagram interpretation, assembly and testing procedures, and diagnosis of relevant products and services. Development of these can lead to present and future educational, vocational, avocational, and life skills; to appreciation of high standards of workmanship and the dignity of work; and to the investigation and solution of technical and sociological problems related to power and energy.

The student should be able to:

- Explore and relate the significance of industrial arts to the needs of individuals, industry, and society.
- Develop safety consciousness and practice in the use of tools, machines, and processes through a wide range of exploratory experiences related to individuals and to production and servicing aspects of relevant hobbies and industries.
- Gain information about the general occupational characteristics of a variety of career fields and to match interests, abilities, likes, dislikes, and values to characteristics of various careers.
- Gain knowledge and skills related to imperial and SI metric systems of measurement and to apply these to measurement activities and problems pertinent to work, energy, and power.
- Develop skills in and to understand the principles of planning and design, and to apply these skills and principles to various facets of power/energy.

- Explore and relate the economic system and the economy to power/energy and consumer awareness.
- Develop knowledge about and skill in the use of hand tools, power tools, and fasteners, and to apply this knowledge and skill to power/energy.
- Recognize the significance of energy sources in the development of civilizations, and to gain information about major and alternate energy sources and their uses and the need for energy conservation.
- Gain an understanding of the principles of energy conversion, to recognize the uses and relationships of the forms of energy, and to apply information about methods of producing electricity from other forms of energy to power/energy projects and products.
- Explore the purposes and methods of power/energy transmission, to recognize the relationship of input, control, transmission, output, and devices to the various transmission processes, to develop pertinent skills, and to apply the electrical transmission process to communication.
- Gain an understanding of various types and uses of power systems and to maintain and repair power systems.

OBJECTIVES: COMMON MODULES FOR ALL AREAS OF STUDY

I. Student Orientation (C)

The student should be able to:

- define Industrial Arts;
- develop an understanding of the role of industrial arts;
- recognize the relationship between junior high school and senior high school industrial arts;
- develop an understanding about the avocational and vocational activities and interests in industrial arts;
- list the subject clusters for junior high school industrial arts;
- identify the areas of study for each of the subject clusters;
- develop an awareness of the modules for each of the areas of study;
- develop an awareness of the industrial arts program in the local school division/school;
- identify reference materials;
- develop the ability to use reference materials;
- identify community resources.

II. Safety (C)

The student should be able to:

- understand the importance of safety;
- identify and follow behavior conducive to safety;
- identify and explain symbols denoting hazards;
- accept responsibility for developing safety habits;
- explain the causes and effects of common industrial accidents;
- demonstrate a knowledge of the organization of the industrial arts laboratory;
- recognize the relationship of laboratory layout to safety;
- recognize the potential hazards of tools, equipment, machines, and materials;
- explain the purpose of proper storage of tools, equipment, and materials;
- explain the importance of safe clothing;
- wear clothing appropriate for industrial arts labortories;

. understand the importance of protective devices;
. use protective devices when required;
. describe daily procedures to be followed in industrial arts laboratories;
. identify and accept responsibility for housekeeping practices;
. identify emergency procedures;
. practice emergency procedures.

III. Careers (C)

The student should be able to:

. develop an awareness of the major groups of occupations;
. collect information about careers related to the major groups of occupations;
. identify careers related to the areas of study in the industrial arts program;
. develop an awareness of skills and aptitudes required for the major groups of occupations;
. identify skills required for specific jobs;
. identify personal interests, abilities, and needs;
. recognize the relationship of attitudes to working conditions;
. identify realistic educational and training plans for specific occupational areas;
. recognize the impact of technology on careers;
. explain the influence of social and economic trends on careers;
. identify the ways in which jobs are advertised;
. understand the purposes of a job description;
. explain the need for a resumé, an application, and an interview.

OBJECTIVES: ELECTRICITY/ELECTRONICS MODULES

I. Student Orientation (C)

II. Safety (C)

III. Careers (C)

IV. Measurement (C)

The student should be able to:

. define measurement;
. explain the importance of measurement;
. recognize the need for standards;
. explain voltage, current, and resistance;
. identify the letter symbols related to voltage, current, and resistance;
. define the basic units of measurement;
. identify the various units of measurement for measuring electricity;
. explain direct current and alternating current;
. draw diagrams illustrating waveforms;
. define power;
. identify the unit of measurement for power;
. describe the origin and importance of Ohm's Law;
. state Ohm's law;
. write, using correct letter symbols, the three forms of Ohm's Law;
. solve problems using the variations of Ohm's Law;
. state the basic power formula;
. write, using correct letter symbols, the three forms of the basic power formula;
. solve problems using the variations of the power formula;
. explain the purpose of conductors, semiconductors, and insulators;

. describe the use of fuses and circuit breakers;
. select meters to measure voltage, current, resistance, and power;
. use meters to measure voltage, current, resistance, and power;
. explain the purpose of resistors;
. interpret a resistor colour code;
. test/measure various electrical/electronic components.

V. Planning and Design (C)

The student should be able to:

. define planning;
. develop an understanding of the importance of planning in electricity/electronics;
. identify the components of planning;
. recognize the fundamentals of design;
. explain the relationship of design to strength, function, materials, cost, and quality;
. identify the steps in the design process;
. identify electrical and electronic symbols;
. read blueprints;
. read and prepare schematic drawings;
. construct and evaluate models and circuits.

VI. Consumerism (C)

The student should be able to:

. define economic system;
. explain the basic parts of economic systems;
. identify basic types of inputs;
. identify human needs;
. explain how electricity/electronics meets human needs;
. recognize the relationship between electricity/electronics and the economy;
. differentiate between needs and wants;
. explain the concepts of quality versus cost and supply and demand;
. describe the effects of inflation;
. identify the positive and negative aspects of credit buying;
. recognize the relationship of energy sources to the services and products of elecrtricity/electronics;
. explain the consequences pertinent to consumption of energy sources;
. justify energy conservation and cost consideration.

VII. Components (C)

The student should be able to:

. identify the various types of components;
. explain the function(s) of each type of component;
. describe the construction of each type of component;
. construct components;
. build and test circuits;
. diagnose and repair electrical/electronic malfunctions;
. produce electrical/electronic products/projects.

VIII. Tools and Fasteners (C)

The student should be able to:

. identify common hand tools;
. use hand tools;

- perform the hand tool processes with increasing accuracy;
- use power tools;
- perform the power tool processes with increasing accuracy;
- define fastening;
- identify methods of fastening;
- use mechanical fasteners and related tools;
- use adhesive fasteners and related tools;
- use fusion fastening methods and related tools.

IX. Energy Sources (C)

The student should be able to:

- recognize the importance of energy supply;
- collect information about the early sources of energy;
- identify major sources of energy;
- describe alternate sources of energy;
- explain the factors related to the supply and use of energy sources;
- recognize the importance of energy conservation.

X. Energy Conversion (C)

The student should be able to:

- recognize the importance of energy;
- define energy conversion;
- explain the process of energy conversion;
- identify the forms of energy;
- recognize the importance and uses of various energy forms;
- identify the forms of energy used to generate electrical energy;
- explain the methods of producing electricity from other forms of energy.

XI. Energy Transmission (C)

The student should be able to:

- define energy transmission;
- recognize the importance of energy transmission;
- define a circuit;
- identify the basic parts of a simple circuit;
- draw a simple circuit;
- construct a simple circuit;
- describe the applications of complete circuits, closed and open circuits, short circuits, series circuits, parallel circuits, and series-parallel circuits to energy transmission;
- construct complete, open and closed, series, parallel, and series-parallel circuits;
- identify the four units in the transmission cycle for electricity;
- recognize the importance of input, control, transmission, and output to the electrical energy transmission process;
- describe the principles governing the application of direct current and alternating current to the transmission of electricity;
- explain the use of transformers in the transmission of electricity;
- describe the operation of step-up and step-down transformers;
- identify the communication devices dependent upon electrical energy and electronic signals;
- explain the communication/transmission process pertinent to communication devices;
- describe the purposes and uses of frequencies in the communication/transmission process;
- explain the relationship of the federal Department of Communication to communication transmission.

XII. Energy Systems (C)

The student should be able to:

- define energy system;
- identify types and uses of energy systems;
- recognize various types of electrical/electronic energy systems;
- identify the uses of various types of electrical/electronic energy systems;
- compare the various types of electrical/electronic energy systems;
- define troubleshooting;
- develop an understanding of the skills related to troubleshooting;
- explain the procedures for analyzing circuit problems;
- use the procedures to locate circuit problems;
- diagnose circuit problems;
- repair basic circuits.

XIII. Electrical Wiring (C)

The student should be able to:

- explain the basic principles of the transmission of electrical energy;
- describe the theory related to the construction of open and closed, series, parallel, and series-parallel circuits;
- identify the various tools and fasteners required for electrical wiring;
- identify the various types and uses of wires, cables, and cords required for electrical wiring;
- explain the purpose of the Canadian Electrical Code;
- recognize the importance of the electrical system;
- identify the main parts of a typical home electrical system;
- explain the importance of electrical plans;
- explain the purpose of the service entrance to a household;
- describe the functions of the various parts of the service entrance;
- explain the use of the distribution panel;
- identify reasons for using circuit breakers and fuses;
- sketch an electrical plan;
- prepare a schematic diagram for circuits in various locations in a house;
- install electrical outlets;
- explain the relationship between switches and the operation of lighting fixtures;
- identify the types of switches;
- sketch a schematic of a lighting circuit using a single-pole, single-throw switch;
- install a simple wall-mounted light fixture and a single-pole, single-throw switch;
- explain schematics of lighting circuits using other types of switches;
- assemble various types of basic circuits used in electrical construction;
- explain the types of basic circuits used in electrical construction;
- describe the purpose of a ground fault interrupter.

OBJECTIVES: POWER MECHANICS MODULES

I. Student Orientation (C)

II. Safety (C)

III. Careers (C)

IV. Measurement (C)

The student should be able to:

- define measurement;
- explain the importance of measurement;
- recognize the need for standards;
- explain the force, energy, work, power, distance, volume, capacity, temperature, pressure, and torque;
- define potential energy and kinetic energy;
- recognize the need for measurement in power mechanics;
- perform various types of measurements;
- solve problems related to measurement in power mechanics.

V. Planning and Design (C)

The student should be able to:

- define planning;
- understand the need for planning;
- identify the components of planning;
- recognize the fundamentals of design;
- explain the relationship of design to strength, function, materials, cost, and quality;
- identify the steps in the design process;
- read drawings;
- prepare drawings;
- construct models.

VI. Consumerism (C)

The student should be able to:

- define economic system;
- explain the basic parts of economic systems;
- identify basic types of inputs;
- identify human needs;
- explain how the services and products of power mechanics meet human and business needs;
- recognize the relationship between power mechanics and the economy;
- differentiate between needs and wants;
- explain the concepts of quality versus cost and supply and demand;
- describe the effects of inflation;
- identify the positive and negative aspects of credit buying.

VII. Tools and Fasteners (C)

The student should be able to:

- identify common hand tools;
- use hand tools;
- perform the hand tool processes with increasing accuracy;
- identify common power tools;
- use power tools;
- perform the power tool processes with increasing accuracy;
- define fastening;
- identify methods of fastening;
- use mechanical fasteners and related tools;
- use adhesive fasteners and related tools;
- use fusion fastening methods and related tools.

VIII. Energy Sources (C)

The student should be able to:

. identify the various sources of energy;
. recognize the relationship of each source of energy to power mechanics;
. compare the various types of liquid and gas fuels;
. describe the function of a fuel system;
. identify the components of a fuel system;
. explain the purpose of each of the components of a fuel system;
. perform carburetor adjustments;
. explain the function of an engine ignition system;
. recognize the different types of ignition systems;
. identify the components of an ignition system;
. explain the operation of the components of an ignition system;
. adjust the ignition system.

IX. Energy Conversion (C)

The student should be able to:

. recognize the importance of energy;
. describe energy conversion;
. explain the operating principle of the internal combustion engines;
. identify the basic components of internal combustion engines;
. explain the functions of the basic components of internal combustion engines;
. define cycle;
. describe the operation of two- and four-stroke cycle engines;
. recognize the application of two- and four-cycle engines;
. compare two- and four-stroke cycle engines;
. identify other types of internal combustion engines;
. explain the operating principles of other types of internal combustion engines;
. recognize the applications of other types of internal combustion engines;
. explain the need for a cooling system in internal combustion engines;
. differentiate between air-cooled and liquid-cooled systems;
. inspect cooling systems;
. identify the functions of lubricating oil;
. describe the basic types of engine lubrication systems;
. select oil for different types of lubrication systems.

X. Transmission of Power (C)

The student should be able to:

. define mechanical power transmission;
. explain the relationship of transmission to input, control, and output in a mechanical power system;
. describe the principles of operation related to mechanical transmission devices;
. describe fluid power transmission;
. identify fluid transmission devices;
. explain the principles of operation related to fluid transmission devices;
. define electrical power transmission;
. describe the various ways of supplying electricity in small engines;
. explain the principles of operation related to electrical power transmission in small engines;
. describe the various uses of electricity in an automobile;
. explain the electrical wiring in an automobile;
. identify the parts of the starting, charging, and ignition system in an automobile.

XI. Routine Care and Maintenance (C)

The student should be able to:

- recognize the need for routine care and maintenance of small engines;
- locate and record information about small engines;
- perform basic routine care and maintenance related to oil supply, cooling system, spark plugs, and air cleaners;
- explain the need for preparing a small engine for storage;
- perform the procedures for storing a small engine;
- prepare a small engine for return to service;
- describe the purpose of a small engine tune-up;
- perform small engine tune-up procedures;
- explain the function of diagnosis;
- perform various diagnostic procedures;
- explain the need for automobile engine maintenance;
- describe the various types of maintenance required on automobile engines.

OBJECTIVES: POWER/ENERGY MODULES

I. Student Orientation C)

II. Safety (C)

III. Careers (C)

IV. Measurement (C)

The student should be able to:

- define measurement;
- explain the importance of measurement;
- recognize the need for standards in measurement;
- describe work, energy, and power;
- define potential energy and kinetic energy;
- perform various types of measurement;
- solve problems related to measurement of work, energy, and power.

V. Planning and Design (C)

The student should be able to:

- define planning;
- understand the importance of planning in power/energy;
- identify the components of planning;
- recognize the fundamentals of design;
- explain the relationship of design to strength, function, materials, cost, and quality;
- identify the steps in the design process;
- collect information from drawings and illlustrations;
- read blueprints;
- read and prepare schematic drawings;
- construct models and circuits.

VI. Consumerism (C)

The student should be able to:

- define economic system;
- explain the basic parts of economic systems;
- identify basic types of inputs;
- identify human needs;
- explain how the services and products of power/energy meet human needs;
- recognize the relationship between power/energy and the economy;
- differentiate between needs and wants;

. explain the concepts of quality versus cost and supply and demand;
. describe the effects of inflation;
. identify the positive and negative aspects of credit buying;
. recognize the relationship of sources of energy to the services and products of power/energy;
. explain the consequences pertinent to the consumption of energy sources;
. justify energy conservation and cost consideration.

VII. Tools and Fasteners (C)

The student should be able to:

. identify common hand tools;
. use hand tools;
. perform the hand tool processes with increasing accuracy;
. identify common power tools;
. use power tools;
. perform the power tool processes with increasing accuracy;
. define fastening;
. identify methods of fastening;
. use mechanical fasteners and related tools;
. use adhesive fasteners and related tools;
. use fusion fastening methods and related tools.

VIII. Energy Sources (C)

The student should be able to:

. recognize the importance of energy supply;
. collect information about the early sources of energy;
. identify major sources of energy;
. describe alternate sources of energy;
. explain the factors related to the supply and use of energy sources;
. recognize the importance of energy conservation.

IX. Energy Conversion (C)

The student should be able to:

. recognize the importance of energy;
. define energy conversion;
. explain the process of energy conversion;
. identify the forms of energy;
. recognize the importance and uses of various energy forms;
. identify the forms of energy used to generate electrical energy;
. explain the methods of producing electricity from other forms of energy.

X. Transmission of Power and Energy (C)

The student should be able to:

. define energy transmission;
. recognize the role of power/energy transmission;
. identify the methods of power/energy transmission;
. define mechanical power transmission;
. explain the relationship of transmission to input, control, and output in a mechanical power system;
. describe the principles of operation in mechanical transmission devices;
. describe fluid power transmission;
. identify fluid transmission devices;
. explain the principles of operation related to fluid transmission devices;

- identify the four units in the transmission cycle for electricity;
- recognize the importance of input, control, transmission, and output to the electrical energy transmission process;
- compare the basic types of transmission paths;
- describe the principles governing the application of direct current and alternating current to the transmission of electricity;
- explain and demonstrate the uses of transformers, conductors, semiconductors, and insulators in the transmission of power and energy;
- identify the communication devices dependent upon electrical energy and electronic signals;
- explain the communication/transmission process pertinent to communication devices;
- describe the purposes and uses of frequencies in the communication/transmission process;
- explain the relationship of the federal Department of Communication to communication transmission.

Power Systems (C)

XI. The student should be able to:

- define power system;
- describe the parts of a power system;
- identify various types of power systems;
- develop an understanding of various types of power systems;
- define troubleshooting;
- develop an understanding of skills related to troubleshooting;
- diagnose problems in power systems;
- maintain and repair power systems.

implementation

IMPLEMENTATION

PROGRAM DESIGN

The curriculum guides have been designed to help teachers meet the needs of adolescents, with relevance to the rapid changes in society. These guides are flexible in order to encourage teachers to use personal knowledge and creativity in planning and implementing programs for each of grades seven, eight, and nine. The program contains the following features:

1. The format of the previous industrial arts curriculum has been changed and the subject content is more comprehensive. The format contains subject clusters, areas of study for each subject cluster, and core and optional modules for each area of study.

2. Practical and theoretical knowledge are interrelated. The content is practical in its purpose, organization and use, and theoretical in recognizing and understanding the concepts of self and interpersonal relationships, and the processes by which problems are solved and decisions are made.

3. Ideally, the curriculum is student-oriented in content and in approach to instruction. Emphasis is placed on creative exploration, self-direction, and independence. Because peer relationships are so important, some group work is emphasized. Instruction should be flexible to accommodate the wide variation in individual growth rates and stages of development.

4. The industrial arts curriculum has clearly defined objectives and program goals which become the criteria by which content is specified, procedures are developed, materials and resources are selected, and evaluative techniques are prepared.

5. Core modules with accompanying objectives have been identified for each area of study. For extended programs and maximum time allotment, teachers are expected to pursue topics beyond the core modules.

6. The sequential order within the subject clusters provides a systematic approach to the development of the program. The following are other approaches which will allow teachers flexibility in selecting learning content and processes to help students develop skills, attitudes, and understanding as bases for making and implementing reasonable, responsible decisions.

   The Process Approach involves the mastery of essential processes, such as searching, classifying, and categorizing information; hypothesizing, testing, valuing, criticizing, planning, problem-solving, and decision-making; and reporting.

   The Project Approach incorporates a number of different educational activities, such as investigating, analyzing, planning, constructing, synthesizing, evaluating, purposing, defining, and relating. The project should be a means to a goal and not the goal itself. The purposes of the project approach are to implement and develop the content and processes related to the area of study, as well as to contribute to the development of individuals.

The Decision-Making Approach is basic to all areas of the program and includes the processes of inquiry, valuing, decision-making, and action.

The Needs Approach assumes that individuals and groups of individuals have certain physical, aesthetic, social, and psychological needs, and is based on meeting those needs.

The Problem Approach, the case study, is based on the observation that individuals, groups, communities, and businesses encounter problems which relate to survival and living in society. The techniques used in the classroom should include a variety of problem situations related to everyday living.

7. Because learning is unique for each student, in every aspect of industrial arts, a rich environment for exploration must be provided. The environment for learning should include attractive, well organized and safe surroundings, suitable and sufficient materials, and good working equipment.

   Learning is facilitated if student purposes are achieved and if the student participates in the selection and planning of classroom projects. Classroom experiences should progress from one successful accomplishment to another.

8. The suggested activities are designed to help students achieve objectives. These experiences help students acquire knowledge, learn skills, evaluate attitudes and values, and develop understanding, appreciation, and perception. The most relevant activities provide the understanding necessary to lead to the achievement of the objective and greater support and credibility to the topic.

   The activities are suggestions only and are intended to provide initial assistance in developing a wide range of activities to meet the students' needs. Students should be involved in the selection of learning experiences. Teachers must consider the cultural background of students, previous experience, and students with special needs to provide maximum opportunities for student learning.

   The structure of the content is the key to the encouragement of further learning.

SCOPE AND SEQUENCE

The subject clusters and areas of study taught will be dependent upon the type of laboratory and equipment. Some of the modules for the areas of study chosen may be taught separately as outlined, or combined. Industrial arts classes may be coeducational, all girls or all boys, or scheduled by class or areas of study selected.

Teachers should emphasize and integrate vocabulary study, safety, consumerism, career information, decision-making, interpersonal relationships, positive attitudes and work habits, communication skills, resource management, needs, values, goals, and laboratory organization throughout the program. To this end, these topics are woven into each area of study.

The scope and sequence should be a developmental progression of tasks and learning related to the areas of study and the modules chosen for each grade level. The

following are criteria to consider when making choices:

1. the logical development of learning in each area;
2. the geographical and cultural background of the students;
3. students' maturation;
4. students' needs, including special needs, developmental tasks, experiences;
5. the amount of repetition that may be justified;
6. provision for new and exciting experiences;
7. the extent to which learning can be extended;
8. the resources available;
9. the most effective use of time, energy, and equipment.

TIME ALLOTMENT

Recommended time allotment for junior high industrial arts is 10% of the total program, 30 minutes daily/150 minutes weekly. One percent of time equals approximately 15 minutes of work per week. It is suggested that industrial arts be scheduled twice in the week or cycle. Different time blocks may have to be planned for students who have to travel to attend industrial arts classes. The time may also limit the number of objectives and/or projects which can be selected. It is recommended that the following flexible time allotments be used for the various grade levels:

. Grade 7 - 10-12%
. Grade 8 - 10-12%
. Grade 9 - 10-12%
. O.E.C. Grades 7, 8, 9 - 14-20%

There should be a balance of time alloted to the theoretic and practical aspects of the program. It is recommended that teaching theory comprise 30-40% of the time allotment and student practice comprise 60-70%. The estimated time listed for each module in the guide should be followed during instruction of theory and practice.

INTEGRATION

Within the industrial arts program, specific approaches and topics may be supportive of other programs in the school. Industrial arts students may share and integrate studies in such subjects as related mathematics, science, communication, and work adjustment (human relations) with mathematics, science, English, and guidance programs. In addition, units on energy and resource management, consummer education, career awareness, safety, and occupational aspects may be developed from topics included in the industrial arts curriculum.

Schools at the middle years level may develop a program for the pre-adolescent as an exploratory program prior to the implementation of industrial arts at the introductory level.

SELECTION OF MATERIALS

The suggested activities in the curriculum refer, in some instances, to approved textbooks and support materials which are basic to these activities. Classroom sets of selected, recommended materials would be desirable. There should be a balance of materials in and among all areas. Additional recommended references for each area of study are included in the bibliography.

The use of a variety of resource materials enriches the experiences of students in individual and group work. Because a wide variety of textbooks and publications are

available in Manitoba schools, each teacher can support instruction with current information, suitable to student needs. Recently published textbooks and support materials are in metric. Industrial arts teachers have been introducing metric measurements and purchasing necessary equipment since Canada's conversion to the SI system.

EVALUATION

Evaluation is part of the education process and is necessary to determine whether the objectives have been met. It should assess various abilities, knowledge, and progress towards some objective(s). It should be considered as an ongoing, cooperative process of making judgments based on documented past and present experiences, with the aim of influencing the direction of future learning experiences.

The areas of study and modules emphasize both the practical aspects of skill mastery and the principles associated with the theories in industrial arts. Students should be involved in evaluating their progress, in determining objectives for the areas of study and the modules, and in selecting methods of evaluation.

PROCESS OF EVALUATION

The purposes of evaluation in a given situation vary according to the needs at the time:

- assessing the attainment of an objective;
- measuring various aspects of learning, such as knowledge, values, and manual skills;
- discovering what students already know;
- motivating students to learn;
- providing information for guidance and counselling;
- providing a basis for curriculum change.

Stating objectives is the first and most important step in the evaluation process. They can be stated in a variety of ways and can provide for cognitive, affective, and psychomotor outcomes at all levels, from simple to complex. The interrelationships among these three domains are evident. Seldom does a learning situation involve only one, and often there are situations which involve all three.

Cognitive objectives should include all six cognitive levels. Affective objectives should help students become aware of their own values and appreciate the need for tolerance of the values of others. Psychomotor objectives should stress the process of learning rather than the product.

Objectives are most effective in evaluation when they are:

- stated in terms of desired student learning outcomes;
- consistent with the structure of the subject matter;
- realistic in terms of students' abilities;
- related to learning principles;
- respective of the needs of the learners.

EVALUATION TECHNIQUES AND METHODS

The following points apply to all evaluation techniques and methods:

- The choice of evaluation procedure will reflect the purposes for which results will be used.
- The greater the variety of evaluation techniques used,

the more probable is a fair judgment.

- Motivation and achievement are affected by the type of evaluation method chosen.
- The intent of an objective and the method used to evaluate should be related.
- To be sound, the procedure selected must measure the content it is chosen to measure.
- The type of subject matter taught affects the choice of evaluation techniques.
- Attitudes are more likely to be positive if students participate in determining objectives, selecting means of evaluation, and evaluating their own progress.
- When learners can use self-evaluation techniques, they are better able to identify their own needs and to take initiative in learning.
- The effectiveness of evaluation techniques is affected by the balance among validity, reliability, usability, and the evaluation techniques selected.

Evaluation techniques may be classified as:

1. Real life situations:
   - observational techniques;
   - peer appraisal and self-report techniques.
2. Simulation techniques.
3. Laboratory management and techniques.
4. Projects. When ranking, quality is important but the time taken to complete the project must also be considered. The project should show evidence of an appreciation of the dignity of craftsmanship and a pride in the high level of achievement.
5. Tests. Tests provide some type of educational feedback that other techniques cannot provide. They include written tests, oral tests, performance tests, and written exercises.

STUDENTS WITH SPECIAL NEEDS

Both gifted students and those with special handicaps may benefit from study in the industrial arts program. Teaching these students successfully requires a sound knowledge of their characteristics and of effective ways of teaching them, and a desire to release the potential of these students for satisfying living.

Special needs may be categorized as:

- Physical - deafness/hearing impairment, blindness/visual impairment, orthopedic handicap, general health impairment.
- Cultural - language and experiential background effects.
- Emotional - ranging from mental illness (severe) to interpersonal relationship problems (less severe).
- Intellectual - general cognitive ability, with particular reference to conceptualization and abstraction.

Administrators and teachers have identified the following five areas of educational needs for special students (the degree of need varies according to the individual):

1. socialization skills;
2. positive self-concept development;
3. daily living activities experiences;
4. independence;
5. employability and occupational skill development.

STRATEGIES TO DEVELOP AN APPROPRIATE PROGRAM

- Be as well informed about students as possible.

- Be aware of impact of various family lifestyles.
- Apply teaching strategies and materials consonant with the students' learning strengths and weaknesses, and cognitive functioning abilities.
- Some teaching strategies are applicable for all learners, regardless of ability; e.g., reinforcement and encouragement, simple clear directions, use of examples, and fostering a caring relationship.
- All students, regardless of handicap, need to learn to read, write, compute, make decisions and solve problems.
- Each student with a special need presents a unique challenge to the teacher to develop basic concepts and skills for that individual to proceed independently to the level of his/her ability.
- Some adaptation of the industrial arts facility and special equipment may be necessary for convenient and safe use of equipment and space. An enriched program may require additional materials and laboratory equipment.
- Essential content and skills are necessary for the handicapped student to master, as well as for everyone else.
- Instruction for the handicapped should be as systematic as possible.
- Content and/or skills should be broken down into small, discrete segments, then linked together in a logical, organized sequence. Sometimes, the teacher needs to decrease the degree of content and/or increase the number of examples to aid the low-ability learner.
- Constant reinforcement is important. Retention problems are reduced if strategies include careful task analysis, hands-on experiences, tactile demonstrations, and recognition of individual differences and needs.
- Encourage the optimal development of the gifted students by enriching the program, employing unusual and challenging teaching and motivational devices, and encouraging students to maintain established high levels of achievement.
- All students should be encouraged to experiment, innovate, search, test, and observe.
- The instructional approach should stimulate students' range of knowledge, skills, and their desire for expanding creative abilities, and provide opportunities to work independently, assume responsibility, and develop leadership abilities.

common modules

COMMON MODULES: Student Orientation,
Safety, Careers

COMMON MODULES

I. STUDENT ORIENTATION (C.) Estimated Time: 3 hours

MAJOR OBJECTIVE: To explore and to relate the significance of industrial arts to the needs of individuals, industry, and society.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate and emphasize this topic throughout all areas of study. Have students prepare and maintain a notebook as an ongoing project. Discuss the purpose of maintaining a well-organized notebook, pointing out that it should help students to build upon ideas and information gained in class. Encourage them to include the following in the notebook project: notes, sketches, illustrations, diagrams, articles from newspapers and technical periodicals, hand-outs, and and instruction sheets.	PURPOSES OF NOTEBOOK PROJECT 1. To provide a record of learning and progress 2. To develop a store of reference informtion
A. PROGRAM OVERVIEW The student should be able to: 1. define Industrial Arts;	Have students locate, discuss, and compare definitions for Industrial Arts. Ask them to formulate their own definition.	INDUSTRIAL ARTS: A phase of general education which serves to familiarize students with the tools, products, processes, and occupations of industry, as well as with the social and economic

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Point out during the discussion of definitions that industrial arts educational programs are pertinent to a body of related subject matter or courses, organized for the development of understanding about the development of understanding about technical, consumer, occupational, recreational, organizational, managerial, social, historical, cultural, and technological aspects of industry. Point out that the programs include experiences (such as experimenting, designing, constructing, evaluating) and processes to develop creativity and problem-solving abilities and to aid individuals in making informed and meaningful occupational choices.	phenomena of their technological world OR A curriculum area which includes these phases of general education dealing with technology--its evolution, utilization, and significance; with industry--its organization, materials, occupations, processes, and products; and with the problems and benefits resulting from the technological and industrial nature of society
2. develop an understanding of the role of industrial arts;	Discuss the role of industrial arts in the general education of students. Relate the discussion to the definition and program goals of industrial arts. Throughout the discussion make students aware of goals which are common to all levels of industrial arts.	Industrial Arts 7-9; Construction, Graphic Communications, Power/Energy, and Manufacturing, Manitoba Department of Education GOALS COMMON TO ALL LEVELS OF INDUSTRIAL ARTS 1. Development of an insight and understanding of industry and its place in our culture 2. Discovery and development of talents, aptitudes, interests, and potentialities of individuals for technical pursuits and applied sciences

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		3. Development of understanding of industrial processes and the practical application of scientific principles 4. Development of basic skills in the proper use of common industrial tools, machines, and processes 5. Development of problem-solving and creative abilities involving materials, processes, and products of industry
3. recognize the relationship between junior high school and senior high school industrial arts;	Describe the relationship between the junior high school and secondary school programs for industrial arts. Have students refer to the goals common to all levels of industrial arts and prepare bulletin board displays, charts, or reports about both levels of programs.	Curriculum guides for senior high school programs in industrial arts
4. develop an understanding about the avocational and vocational activities and interests in industrial arts.	Explain the terms avocation and vocation. Discuss the similarities and differences between avocational and vocational activities pertinent to industrial arts. Emphasize how laboratory activities and projects develop knowledge and skills to attain both the avocational and vocational goals of industrial arts. Make students aware of the recreational aspects of industrial arts. Provide information	AVOCATION: An activity engaged in, usually for enjoyment, in addition to one's regular work or profession VOCATION: A regular occupation or profession. usually requiring special aptitude or qualifications

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	about and experience in the basic processes of various types of industries so that students may be more competent to choose vocations. Have students prepare collages, displays, posters, brochures, or reports about the avocational and vocational aspects of industrial arts.	
B. JUNIOR HIGH SCHOOL INDUSTRIAL ARTS The student should be able to:		
1. list the subject clusters for junior high school industrial arts;	Make students aware of the subject clusters in the industrial arts program for the junior high schools in Manitoba. Provide information about each of the subject clusters.	SUBJECT CLUSTERS FOR INDUSTRIAL ARTS IN THE JUNIOR HIGH SCHOOL 1. Construction 2. Graphic Communications 3. Power/Energy 4. Manufacturing
2. identify the areas of study for each of the subject clusters;	Point out the areas of study pertinent to each of the subject clusters. Have students collect information about and prepare diagrams, charts, and posters to illustrate the relationship between the areas of study and the subject clusters. Discuss purposes of studying the subject clusters and have students prepare illustrated reports/brochures. Have them identify and discuss some of the	SUBJECT CLUSTERS / AREAS OF STUDY 1. Construction — Construction 2. Graphic Communications — Drafting, Graphic Arts, Graphic Communications

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	industrial processes and technological developments for each area of study.	SUBJECT CLUSTERS / AREAS OF STUDY 3. Power/Energy — Electricity/ Electronics; Power Mechanics; Power/Energy 4. Manufacturing — Metalwork; Plastics; Woodwork; Manufacturing
3. develop an awareness of the modules for each of the areas of study;	Prepare transparencies, charts, posters, brochures, or handbooks to provide students with information about the various modules in each of the areas of study. Have students discuss the correlation of the modules to the areas of study and the subject clusters.	Industrial Arts 7-9, Manitoba Department of Education
4. develop an awareness of the industrial arts program in the local school division/ school.	Discuss the industrial arts subject clusters and areas of study available in the school division and school. Take students on a tour of the laboratory/laboratories and provide them with handouts describing the program.	Industrial arts laboratories
C. RESOURCE MATERIALS	Integrate instruction in the use and care of reference materials throughout	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	industrial arts program.	
The student should be able to:		
1. identify reference materials;	Prepare a display of reeference materials related to industrial arts, and explain them. (Or ask the librarian to prepare a display and explain the materials.)	REFERENCE MATERIALS 1. Catalogues 2. Service manuals 3. Directories (city, telephone, trade) 4. Machine equipment and tool manuals 5. Textbooks 6. Periodicals 7. Audio-visual materials
2. develop the ability to use reference materials;	Provide students with opportunities to use the reference materials for technical research, report writing, problem solving, and projects.	
3. identify community resources.	Discuss and have students assist in listing industries, speakers, and other community resources that could enhance teaching/learning strategies for industrial arts.	Lists of industries, speakers, and other community resources

II. Safety (C.) Estimated Time: 4 hours

MAJOR OBJECTIVE: To develop safety consciousness and practice in the use of tools, machines, and processes through a wide range of exploratory experiences related to individuals and to production and servicing aspects of relevant hobbies and industries.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate and emphasize safety instruction and practice throughout all areas of study in the industrial arts program. Provide a continuous safety program related to each area of study.	
A. SAFETY AWARENESS The student should be able to:		
1. understand the importance of safety;	Discuss the contribution of knowledge, skills, and positive attitudes to safe living and working conditions in homes, schools, and communities.	On Guard (colour filmstrip, cassette, program guide), Prentice-Hall If I Had a Hammer (16 mm colour film), Manitoba Department of Education
2. identify and follow behavior conducive to safety;	Discuss the importance of safe behavior and practices. Develop with the class a set of rules for behavior. Make them aware of the reasons for each rule. Have them prepare posters, charts, or transparencies of the rules. Observe students and emphasize that each must act responsibly at all times to ensure personal and group safety.	Tips For New Employees (slides), available from Workplace Safety and Health Division, Department of Labour and Manpower, Norquay Building, Winnipeg, Manitoba R3C 0P8

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. identify and explain symbols denoting hazards;	Show students the various symbols denoting hazards: fire, explosion, poison, and others. Encourage students to study charts and posters to learn symbols for safety hazards.	The Safety Program (colour filmstrip, cassette, program guide), Prentice-Hall General Shop Safety (colour, sound filmstrip), Vocational Filmstrip Company
4. accept responsibility for developing safety habits;	Make students aware that they are responsible for safety. Emphasize that safety in the home, classroom, industrial arts laboratory, school, and community means protecting oneself and others from possible injury and danger. Explain and demonstrate the ABC of safety: Always Be Careful! Remind students frequently about the need to be safety conscious by integrating safety instruction throughout all areas of study in the program.	Safety/Health Guide for Industrial Arts, Vocational Industrial, Home Economics, and Business Education, Manitoba Department of Education The Workplace Safety and Health Act, Manitoba Statutes, Queen's Printer Safety Attitudes (slides), available from Workplace Safety and Health Division, Department of Labour and Manpower, Norquay Building, Winnipeg, Manitoba R3C OP8
5. explain the causes and effects of common industrial accidents.	Discuss the relationship between causes and effects of accidents. Assign readings from reference materials, periodicals, and daily newspapers for class discussion on industrial accidents. Invite guest speakers to speak on accidents and their prevention. Explain the relationship between safety requirements used in the industrial arts labortory and those used in industry.	Everything to Lose, The Split Second, (16 mm colour films), available from the Workplace Safety and Health Division, Department of Labour and Manpower, Norquay Building, Winnipeg, Manitoba R3C OP8 Occupational Health and Safety: A Training Manual, Copp Clark Pitman It's Happened Before (16 mm colour film), Film Library, Manitoba Hydro

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
B. ORGANIZATION OF LABORATORY The student should be able to:		
1. demonstrate a knowledge of the organization of the industrial arts laboratory;	Take students on a tour of the industrial arts laboratory/laboratories and emphasize the relationship among safety, cleanliness, and organization. Encourage students to study safety charts, posters, and signs placed around the laboratory/laboratories. Have them locate fire extinguishers, first-aid kits, telephones, and fire exits.	Industrial arts laboratories Student work stations Safety charts, posters, signs Setting Up Shop Safety Lectures (program), Workplace Safety and Health Division, Department of Labour and Manpower, Norquay Building, Winnipeg, Manitoba R3C 0P8
2. recognize the relationship of laboratory layout to safety;	Make students aware that the laboratories provide an environment for the development of safety concepts and habits that can guide their actions in all life situations. Assess and discuss the layout of each laboratory with students. Have students list the limitations and unsafe conditions in the layout of each laboratory and suggest procedures for coping with these.	Confined Space Hazards (16 mm colour film), Workplace Safety and Health Division, Department of Labour and Manpower, Norquay Building, Winnipeg, Manitoba R3C 0P8

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Emphasize the importance of orderliness and safety in the laboratory. Point out areas where accidents can happen.	
3. recognize the potential hazards of tools, equipment, machines, and materials;	Show students the difference between the incorrect and correct way to use and handle tools, equipment, machines, and materials. Have students practice correct usage and handling techniques. Make students aware of how accidents occur and how to avoid them.	Using Hand and Bench Tools, Operating Power Machines (colour filmstrips, cassettes, program guide), Prentice-Hall
4. explain the purpose of proper storage of tools, equipment, and materials.	Identify and discuss the storage areas requisite for various tools, equipment, and materials. Point out why proper storage areas are essential for safety in each laboratory.	
C. CLOTHING AND PROTECTIVE DEVICES The student should be able to:		
1. explain the importance of safe clothing;	Discuss the relationship of clothing to the work being done and to safety in each laboratory. Have students, individually or in groups, prepare bulletin board displays, charts, and posters about safe clothing requisite for each area of study.	Bulletin board displays, charts, posters

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. wear clothing appropriate for industrial arts laboratories;	Have students examine and demonstrate the use of clothing applicable to each industrial arts laboratory. Point out the hazards associated with loose clothing, neckties, jewellery, long hair, and long sleeves. Have students demonstrate methods of overcoming these hazards.	Your Feet Are Your Fortune (slides), Workplace Safety and Health Division, Department of Labour and Manpower, Norquay Building, Winnipeg, Manitoba R3C OP8
3. understand the importance of protective devices;	Identify and explain the purpose of various protective devices. Discuss and demonstrate methods of sanitizing protective devices, such as safety glasses, protective hearing devices, and respirators.	PROTECTIVE DEVICES 1. Gloves 2. Safety glasses 3. Respirators 4. Hard hats 5. Hearing devices (ear plug, ear muff) 6. Footwear 7. Safety stamps 8. Hair bands/nets 9. Machine guards 10. Aprons
4. use protective devices when required.	Demonstrate the proper use of protective devices. Insist that students use protective devices when needed. Use posters, charts, transparencies, slides, photographs, and films to show the correct use of protective devices. Place safety posters near machines and equipment.	Protecting Your Eyes (colour filmstrip, cassette, program guide), Prentice-Hall The Sound of Sounds, We'll See Tomorrow (16 mm colour films), and Guard Your Sight (slides), Workplace Safety and Health Division, Department of Labour and Manpower, Norquay Building, Winnipeg, Manitoba R3C OP8

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
D. PROCEDURES The student should be able to:		
1. describe daily procedures to be followed in industrial arts laboratories;	Identify and discuss the daily procedures for industrial arts laboratories. Have students prepare charts of daily procedures to follow. Make students aware of the relationship of well-organized daily procedures to safety.	
2. identify and accept responsibility for housekeeping practices;	Point out that good housekeeping practices aid in preventing accidents, as well as in providing a pleasant, well-organized environment for work and learning. Have students accept responsibility for routine daily housekeeping activities like these: . daily removal of all waste materials; . establishment of safety zones to maintain required aisle and work space around machines; . clean-up of shop equipment and floors at the end of each period; . reporting of unsafe tools, equipment, and machines.	Housekeeping Means Safekeeping (16 mm colour film), and Keep It Clean for Safety's Sake (slides), Workplace Safety and Health Division, Department of Labour and Manpower, Norquay Building, Winnipeg, Manitoba R3C 0P8
3. identify emergency procedures;	Make students aware of emergency procedures related to fire, first-aid, and accidents.	The A, B, C's and D's of Portable Fire Extinguishers (16 mm colour film), Film Library, Manitoba Hydro

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
4. practice emergency procedures.	Review and practice emergency procedures for leaving the laboratory. Discuss location and use of emergency equipment, such as fire extinguishers and panic buttons. Explain the importance of an easily accessible, properly maintained and marked first-aid kit. Emphasize that serious injuries require only emergency first-aid, since they must be treated by qualified medical personnel. Establish a procedure for reporting all accidents, no matter how trivial. Explain the purpose of accident report forms. Have students complete accident report forms. Make them aware of the function of and the benefits available under the Workers' Compensation Act.	Preparing for Emergencies; Wounds, Sprains, Fractures; Shock, Fainting, Burns; Artificial Respiration (colour filmstrips, cassettes, program guide), Prentice-Hall Examples of accident report forms The Workers' Compensation Act, Manitoba Statutes, Queen's Printer

III. CAREERS (C.) Estimated Time: 3 hours

MAJOR OBJECTIVE: To gain information about the general occupational characateristics of a variety of career fields and to match interests, abilities, likes, dislikes, and values to characteristics of various careers.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate and emphasize career instruction throughout all areas of study in the industrial arts program. Provide specific career information for each area of study.	
A. CAREER CLASSIFICATIONS The student should be able to:		
1. develop an awareness of the major groups of occupations;	List and outline the major occupational groups. Discuss important points to consider in studying occupations. Use assignment sheets based on The Canadian Classification and Dictionary of Occupations.	The Canadian Classification and Dictionary of Occupations, Department of Manpower and Immigration, Canada
2. collect information about careers related to the major groups of occupations;	Encourage students to begin the preparation of well-organized and indexed career folders to cover intensive studies of various careers. Point out the relationship between careers in major groups of occupations and the eleven areas of study in the industrial arts program.	Training Manual for Canadian Classification and Dictionary of Occupations, Volume I, Department of Manpower and Immigration, Canada Industrial Arts 7-9: Construction, Graphic Communications, Power/Energy, and Manufacturing, Manitoba Department of Education

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. identify careers related to the areas of study in the industrial arts program.	Have students discuss and prepare charts, posters, or reports for career folders showing the realtionship between possible career choices and the areas of study. Organize the instructional program in order to clarify the kinds of jobs that are related to each area of study.	Aircraft Mechanic, Architectural Drafting, Career of an Auto Mechanic, A Career in Cabinet Making, Careers in Graphic Arts: Silkscreening, The Electrician Kit, The Machinist in the Plastic Moulding Industry, Sheet Metal Working Is . . . (colour slides, audio cassettes, carousel slide trays), Department of Education Library, 1181 Portage Avenue, Winnipeg, Manitoba R3G OT3
	Implement a career informtion centre or corner in the laboratory or classroom.	Electricity and Basic Electronics, The Goodheart-Willcox, Chapter 20
	Have students assist with the organization and sponsorship of a career fair in the laboratory, school, or community shopping centre. Ask students to select three occupations and show the training requirements for each.	Experiences with Electrons, South-Western Publishing, Unit1-Topics 1 and 2
B. SKILLS AND APTITUDES The student should be able to:		
1. develop an awareness of skills and aptitudes required for the major groups of occupations;	Review the many types of occupations and careers pertinent to the major groups of occupations in Canada. Have students discuss and locate similar information for the major groups of occupations in Manitoba.	The Canadian Classification and Dictionary of Occupations, Department of Manpower and Immigration, Canada

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Ask students to prepare lists or maps giving locations of local industries/ businesses and identifying the major occupations related to these. Have students develop a classroom file of local occupations. Discuss the relationship of industrial arts to the various types of occupations and the skills and aptitudes required for major occupational groups.	Canada Year Book and Canada Handbook, Statistics Canada Careers Manitoba, Volumes 1, 2, 3, 4, Employment and Immigration, Canada The Manitoba Career Guide, Manitoba Department of Education Manitoba Trade Directory, Sanford Evans Publishing Telephone and city directories Newspapers
2. identify skills required for specific jobs;	Provide students with job descriptions and job titles that illustrate the variety of jobs in various industries. Have students research job descriptions to select jobs of their choice. Have them identify the skills these jobs require. Provide students with a list of educational and training programs related to major occupational areas and specific jobs. Have them prepare charts, posters, or reports on the educational requirements of specific jobs.	The Canadian Classification and Dictionary of Occupations, Department of Manpower and Immigration, Canada Textbooks for each of the areas of study in industrial arts

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. identify personal interests, abilities, and needs;	Have students analyze personal interests and abilities by completing a self-assessment inventory at the beginning of the first year and at the end of the final year in the industrial arts program. Have them include the following in the self-assessment inventory: interests, skills, likes, dislikes, goals, etc. Point out that each individual wishes to fulfill certain needs, hopes, and goals in a job. Have students identify and rank the ten most common needs and hopes related to a job. Encourage them to discuss the merits of the choices and the ranking of the needs and hopes. Emphasize that in order to make decisions about future careers, individuals must keep up-to-date, complete information about their abilities, interests, hopes, and achievements, as well as current information about many jobs. Have students compare information about themselves with information about jobs. Indicate that this process will assist them in making appropriate career decisions. Point out that self-evaluation of interests and abilities provides the foundation for personal career planning.	Self-assessment inventory forms Careers, Reed Career Service (bi-monthly) Current job information The Index to Canadian Occupations (kit), Canadian Government Publishing Centre

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
4. recognize the relationship of attitudes to working conditions;	Have students discuss and identify the attitudes that help people achieve on the job. Point out that regardless of future employment, students will be expected to work with others in a variety of situations. Explain the importance of good manners, cheerfulness, and punctuality. Emphasize pride in work, self-worth, safety consciousness, regular attendance, cooperation, industriousness, and friendliness. Have students prepare charts, posters, reports on indicators of good attitudes. Use ccase problems, in-class decision-making exercises, and out-of-class decision-making exercises, and out-of-class group projects to develop human relation skills in students.	INDICATORS OF A GOOD ATTITUDE 1. Punctuality 2. Attendance 3. Neatness 4. Honesty 5. Cooperation 6. Friendliness 7. Industriousness 8. Self-confidence
5. identify realistic educational and training plans for specific occupational areas;	Review skills required for specific jobs, identification of personal interests, abilities, and needs, and comparison of personal information about jobs. Have students match personal credentials with educational and vocational opportunities and requirements by completing an occupational analysis form. Relate the occupational analysis to the area of study in the industrial arts program. Point out that the completion of an occupational analysis form for each job studied will provide important clues about future educational and vocational goals.	Creating a Career Program, Canadian Government Publishing Centre Occupational analysis forms REED CAREER SERVICE VIDEOTAPE CAREER AWARENESS RESOURCE LIBRARY Carpentry B-2 Chemical and Plastics Processing F-1 Concrete Finishing B-3 Drafting O-4 Electrical and Electronic Engineering A-8 Electrical Power, Lighting and Wire

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		Communications B-4 Electronic Products Manufacturing G-6 General Manufacturing G-8 Graphic Arts O-6 Insulating and Roofing Occupations B-6 Mechanics O-9 Metal Machining G-11 Metal Products F-4 Metal Shaping and Forming G-12 Photography D-5 Photographic Processing O-13 Plastering, Painting and Paper Hanging B-8 Printing O-14 Rubber and Plastic Products Manufacturing G-14 Sheet Metalwork G-15 Wood Processing F-9 Wood Products Manufacturing G-19
6. recognize the impact of technology on careers;	Discuss the influence of technology on employment trends, life styles, and speed of change. Point out the changes in jobs and roles of employees. Make students aware that technological developments, career preparation, and planning for contingencies are related. Have students assess the extent to which technological change may downgrade or upgrade a given occupation by affecting the employment opportunities and occupational requirements.	"The Thinking ?? Machine," "Incredible Machine" (films), Manitoba Telephone System, Public Relations Department Humanized Technology (video recording and viewer's guide), Fast Forward Series I Implications (video recording and viewer's guide), Fast Forward Series 2

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
7. explain the influence of social and economic trends on careers.	Identify and discuss social and economic trends and their effects on social and economic aspects of various occupations. Ask students to assess the future social and economic status of a given occupation. Have them identify alternatives that could be pursued if technological change were to eliminate the given job. (Alternatives should require similar training and experience.)	Newspapers Radio and television news
C. JOB-SEARCH TECHNIQUES The student should be able to:		
1. identify the ways in which jobs are advertised;	Discuss methods used to advertise jobs. Have students collect and discuss examples of job advertisements and prepare charts, posters, or bulletin board displays.	JOB ADVERTISEMENT SOURCES 1. School guidance counsellors 2. Canada Manpower 3. Employment agencies 4. Newspapers, periodicals
2. understand the purposes of a job description;	Obtain or write job descriptions. Have students assess the advantages and disadvantages of job descriptions. Ask them to discuss the purposes of job descriptions and then list these.	PURPOSES OF JOB DESCRIPTIONS 1. Outline duties 2. Describe routines 3. Assign responsibility 4. Delegate authority 5. Designate accountability 6. Prevent conflicts

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		7. Describe general ability requirements 8. Categorize personnel 9. List expected skills and attitudes 10. State desired education
3. explain the need for a resumé, an application, and an interview.	Have students collect examples of resumés, letters of application, and application forms. Have them explain the purposes and compare the format and content of resumés, letters of application, and application forms. Point out that application forms and resumés often contain similar information. Ask students to write a resumé and a letter of application and complete an application form for a specific job description or advertisement. Discuss interview processes and techniques. Emphasize that students will be expected to communicate in all career situations. Make them aware that communication starts with an application form and interview and continues with company/business reports and interaction with customers and co-workers. Point out the importance of basic reading, writing, speaking, and computing skills, and assist students to develop these in all class activities.	Resumés Letters of application Application forms

electricity/electronics

CORE MODULES: Student Orientation, Safety, Careers, Measurement, Planning and Design, Consumerism, Components, Tools and Fasteners, Energy Sources, Energy Conversion, Energy Transmission, Energy Systems, Electrical Wiring

ELECTRICITY/ELECTRONICS

I. STUDENT ORIENTATION (C.) Estimated Time: 3 hours

MAJOR OBJECTIVE: To explore and relate the significance of industrial arts to the needs of individuals, industry, and society.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	NOTE: Refer to Common Modules for Module I, Student Orientation. Emphasize that people depend on electrical and electronic devices, and that modules in Electricity/Electronics will explain basic theory and, through projects, provide opportunities to explore the basic principles. Explain the two terms: electricity and electronics. Emphasize that electricity and electronics are truly amazing by conducting a "brainstorming" session about their uses in homes, industries, entertainment, medicine, transportation (including spaceships and satellites), computer technology, and many other facets of life.	Industrial Arts 7-9: Power/Energy (Electricity/Electronics, Power Mechanics, Power/Energy), Module I, Student Orientation Joint Explorations Program for Home Economics/Industrial Arts, Interim Guide, Manitoba Department of Education The Basic Book of Electricity and Electronics, American Technical Society, Unit 1 ELECTRICITY: A field of study relating to circuit systems in which electrons flow primarily through solid-wire conductors of various forms ELECTRONICS: A field of study relating to circuit systems in which electron tubes and solid-state devices, such as diodes and transistors, control the flow of electrons

II. SAFETY (C.) Estimated Time: 4 hours

MAJOR OBJECTIVE: To develop safety consciousness and practice in the use of tools, machines, and processes through a wide range of exploratory experiences related to individuals and to production and servicing aspects of relevant hobbies and industries.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	NOTE: Refer to Common Modules for Module II, Safety. Emphasize the following: a) Students studying the basics of electricity/electronics must learn safety precautions. b) The right way of doing a job is the safe way. c) The use of safety precautions provides protection against injury. d) Safety is a matter of common sense and good judgment. e) Applying safety precautions in all laboratory activities is essential to making them a part of regular work habits. Point out that there is always an element of danger while working with electricity and electronics. Make sure students observe safety rules for each project. Tell them not to make contact with any live wire or terminal regardless of whether it is connected to low or high voltage. Draw attention to these statements by means of	Industrial Arts 7-9: Power/Energy (Electricity/Electronics, Power Mechanics, Power Energy), Module II, Safety The Basic Book of Electricity and Electronics, American Technical Society, Unit 2 Understanding Electricity and Electronics, McGraw-Hill, Section 1, Unit 4 Energy: Electricity/Electronics, South-Western Publishing, pp. xiii-xiv Basic Industrial Arts (Electricity, Metalworking, Drafting, Woodworking), McKnight Publishing, pp. EL-13-EL-15 Electricity and Basic Electronics, Goodheart-Willcox, pp. 7, 8, 38, 47, 70, 79-81, 116, 119, 121-122, 213 Understanding Electricity and Electronics, 4th ed., McGraw-Hill, Unit 4

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	charts, posters, or other visual devices: a) Respect electricity and it will serve you well. b) Treat electricity carelessly and you may receive the SHOCK OF YOUR LIFE. Ask students to prepare displays or audio-visual presentations about safety in electricity/electronics, reports about electric shock, and lists of electrical safety practices that could be improved or initiated in homes, schools, and industrial and business complexes.	Electrical Safety From A to Zap, Electricity--Handle With Care, Don't Be Shocked, Electrical Safety in Construction, Electrical Safety Around the Farm, Play It Safe, Electrically (colour films), Manitoba Hydro

III. CAREERS (C) Estimated Time: 3 hours

MAJOR OBJECTIVE: To gain information about the general occupational characteristics of a variety of career fields and to match interests, abilities, likes, dislikes, and values to characteristics of various careers.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	NOTE: Refer to Common Modules for Module III, Careers. Integrate career instruction throughout this area of study by familiarizing students with both the many career choices and the foundations on which these are based, and by encouraging them to evaluate themselves in relation to career opportunities and future goals. Point out that a knowledge of career opportunities in electricity/electronics will aid students in determining future educational and vocational endeavours.	Industrial Arts 7-9: Power/Energy (Electricity/Electronics, Power Mechanics, Power/Energy), Module III, Careers CAREERS C - Concern, Cooperation, Choice, Competence A - Appearance, Attendance, Attitude R - Reading, 'Riting, 'Rithmetic, References E - Experience, Equality, Example E - Effective Use of Time R - Respect, Recognition S - Spirit Experiences with Electrons, South-Western Publishing, Unit I, Topics 1 and 2 Understanding Electricity and Electronics, McGraw-Hill, Section 1, Unit 5 Basic Industrial Arts (Electricity, Metal Working, Drafting, Woodworking), McKnight Publishing, Chapter 7

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Create an awareness of occupational families related to Electricity/ Electronics. Prepare students for advanced vocational and technical study by providing them with information and experiences related to electricity/electronics in general and to current practices in industry in specific. Acquaint them with programs available in secondary schools, community colleges, and universities. Encourage students to prepare reports, bulletin board displays, and charts about the education required for these jobs: electrical or electronic engineers, electric power and lighting designers, engineering technicians, radio and television service technicians, broadcast technicians, telephone workers, appliance service workers, business-machine service workers, construction and maintenance electricians, automotive service workers, electrical utility line workers, computer technicians, and space-technology technicians.	The Basic Book of Electricity and Electronics, American Technical Society, Unit 1 Electricity and Basic Electronics, Goodheart-Willcox, Chapter 20 Electricity and Electronics, Goodheart-Willcox, Chapter 21 Explorations in Electricity and Electronics, McGraw-Hill Ryerson. Unit 1

IV. MEASUREMENT (C.) Estimated Time: 15 hours

MAJOR OBJECTIVE: To gain knowledge and skills related to imperial and SI metric systems of measurement and to apply these to measurement activities and problems pertinent to electricity and electronics.

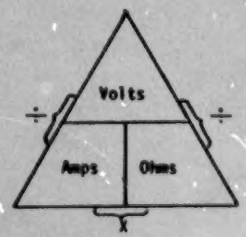
TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate the instruction, application, and practice of measurement, along with the critical thinking and safety procedures related to it, throughout the modules in this area of study.	
A. INTRODUCTION TO MEASUREMENT The student should be able to:		
1. define measurement;	Have students discuss and define measurement. (Students should enter this definition, along with others that arise from this area of study, in a notebook.) Point out that measurement is a process of comparing an unknown to a known quantity and that different units of measurement exist for different items.	MEASUREMENT: A method of communicating size, shape, distance, and weight Experiences with Electrons, South-Western Publishing, Unit VIII-Topic 1
2. explain the importance of measurement;	Make students aware of the relationship of measurement to electricity/electronics. Point out that measuring devices are needed to identify the presence of electricity because it cannot be seen.	Electricity and Basic Electronics, Goodheart-Willcox, Chapter 8

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. recognize the need for standards;	Explain that standards for measuring electricity have been developed over the years and agreed upon by organizations such as ISO, ANSI, and CSA, with representation from many industries. Indicate that these standards, the same throughout the world, aid in communicating information pertinent to electrical measurements. Inform students that published standards define measurement of length, volume, weight, time, electricity, and other values.	ISO: International Organization for Standardization ANSI: American National Standards Institute CSA: Canadian Standards Association Standard Measurement (16 mm colour film), Library, Manitoba Department of Education
4. explain voltage, current, and resistance;	Make students aware that to determine the presence of electricity, the voltage/force, the current/movement, and the resistance/opposition to flow must be measured. Point out that electrons do not move in any definite pattern until a force is applied to make them flow in one direction. Indicate that voltage is a static/non-moving pressure or force of electricity; that current is the movement of electricity over a conducting path; and that resistance is the opposition to the flow of electrical current by a material, substance, component, or device. Explain that the electromotive force/voltage must be present before current can flow and resistance can oppose the current's flow. Use the analogy of the flow of water through a water faucet or a squirt gun to explain voltage, current, and resistance.	

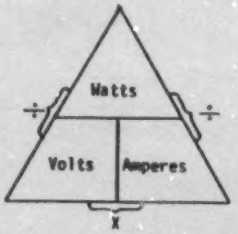
TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Have students discuss and define these electrical terms: voltage, current, resistance.	VOLTAGE: The electromotive force (emf) that causes electrons to move along a conductor through a circuit, or that causes current to flow CURRENT: The movement of electrons through conductor material, or the flow of electrons in a negative-to-positive direction along a conductor RESISTANCE: The tendency of a device or a circuit to oppose the movement of current through it
5. identify the letter symbols related to voltage, current, and resistance;	Have students research literature to locate the letter symbols for voltage (V or E), current (A or I), and resistance (R). Emphasize that E refers to electromotive force; I, to intensity of current flow; and R, to opposition or resistance to the flow of electrons.	The Electron Theory, Circuits, Symbols and Diagrams (colour filmstrips, cassettes), McIntyre Educational Media
6. define the basic units of measurement;	Explain that the basic unit of measurement for voltage is volt, for current is ampere, and for resistance is ohm. Have students discuss and define the units of measurement. Explain that an electric circuit has a resistance of one ohm when one ampere flows through it with a measure of one volt.	VOLT: The unit of measurement for electromotive force or voltage AMPERE: The unit of measurement for flow of electric current, or for a specific quantity of electrons OHM: The unit of measurement for electrical resistance, abbreviated with the Greek letter omega (Ω)

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
7. identify the various units of measurement for measuring electricity;	Make students aware of the choice of units for measuring electricity. Acquaint them with the prefixes used with the basic units of measurement to measure units less than one and to simplify measurement of very large quantities. Discuss the following terms: milliamperes, microamperes, millivolts, microvolts, kilovolts, kilohms, megavolts, megohms. Have students define these terms and have them locate examples of the various ways of writing the terms; e.g., 4 millivolts or 4mV, 10 kilohms or 10K ohms. Encourage students to do research for illustrated reports about the numerical prefixes.	ELECTRICAL PREFIXES Quantity — Prefix 1,000,000 — Mega(M) 1,000 — Kilo(k) 0.001 — Milli(m) 0.000 001 — Micro(μ) Experiences With Electrons, South-Western Publishing, Part VIII, Unit 7
8. explain direct current and alternating current;	Discuss and have students define direct current and alternating current. Point out that direct current, often designated DC, has polarity, flows in one direction from negative to positive, and can be produced by batteries and generators. Emphasize that alternating current, called AC, changes direction or reverses flow at regular intervals, is generated by alternators or generators, and can be changed to direct current by the use of a rectifier.	Introduction to DC Circuit Problems (colour filmstrips, casettes, workbook/study guide), Prentice-Hall Media Experiences With Electrons, South-Western Publishing, Part VIII, Unit 5 Electricity and Basic Electronics, Goodheart-Willcox, Chapter 8
9. draw diagrams illustrating waveforms;	Demonstrate and have students diagram and label waveforms for DC and AC current.	Experiences With Electrons, South-Western Publishing, Part VI, Unit 2

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Acquaint students with the term frequency, and explain its relationship to alternating current, to diagrams of waveforms, and to the basic unit of measurement, hertz, and/or cycles per second/cps.	
10. define power;	Have students define power. Discuss this definition in relation to electrical power.	POWER: The rate of doing work, specifically, the rate of doing work electrically (abbreviated P)
11. identify the unit of measurement for power.	Point out that electrical power, designated P, is measured in watts. Acquaint students with these terms: kilowatt/kW, kilowatt hours/kWh, milliwatt/mW, microwatt/ W, and joule. Explain that joule equals one watt per second, and is a term widely used in countries employing the metric system.	
B. OHM's LAW		
The student should be able to:		
1. describe the origin and importance of Ohm's Law;	Have students prepare an illustrated report telling about George Simon Ohm and his discovery of the relationship among voltage, current, and resistance.	
2. state Ohm's Law;	Point out that Ohm's Law is a basic electrical law that states the relationship among voltage, current, and resistance and emphasize the following:	Experiences With Electrons, South-Western Publishing, Part III, Unit 4

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	a) One volt pushes one ampere of current through one ohm of resistance. b) The greater the voltage in a circuit, the greater the current flow. c) The greater the resistance in a circuit, the less the current flow.	Electricity and Basic Electronics, Goodheart-Willcox, Chapter 5
3. write, using correct letter symbols, the three forms of Ohm's Law;	Indicate that when students use Ohm's Law, they work with three variables: voltage, current, resistance. Explain that the formula for the basic Ohm's Law is stated this way: Voltage = Current x Resistance. Point out that to express the basic formula, E = IxR, the letter E (electromotive force) is used instead of the word voltage; the letter I (intensity of current flow), instead of the word current; the letter R (the opposition to the flow of electrons), instead of the word resistance. Explain that the formula is used to find the value of one variable if the other two are known; thus, it may be stated in these ways: I = E ÷ R/I = E/R, when solving for current; and R = E ÷ I/R = E/I, when solving for resistance. Indicate that E will be expressed in volts, I, in amperes, and R, in ohms. Acquaint students with the triangle for Ohm's Law.	TRIANGLE FOR OHM'S LAW 

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
4. solve problems using the variations of Ohm's Law;	Demonstrate a practical application of Ohm's Law. Have students use the information from the demonstration, the formulas, and the triangle for Ohm's Law to solve problems.	Simple Circuits and Networks: Ohm's Law (colour filmstrips, cassettes, workbook/study guide), Prentice-Hall Media Exploratory Electronics Laboratory Model 555 (kit and trainer), Lab Volt
5. state the basic power formula;	Point out that the basic power formula shows the relationship among electric power and voltage, current and resistance, and may be stated as Power = Voltage x Current. Have students list common electrical and electronic devices and the power consumption for each. Discuss the relationship of the power formula to power consumption.	The Basic Book of Electricity and Electronics, American Technical Society, Unit 13 Exploring Electricity/Electronics with the Electrical Team, Delmar Publishers, Unit 15
6. write, using correct letter symbols, the three forms of the power formula;	Discuss the relationship of the power formula to Ohm's Law. Indicate that the power formula has these variables: power, voltage, and current. Point out that to express the basic formula, P = E x I, the letter P (power) is used instead of the word power; the letter E (electromotive force), instead of the word voltage; the letter I (intensity of current flow), instead of the word current. Explain that the formula is used to find the value of one variable if the other two are known; thus, it may be stated in these ways: E = P ÷ I/E = P/I, when solving for voltage; I = P ÷ E/I = P/E, when solving for current.	Energy: Electricity/Electronics, South-Western Publishing, pp. 20-22 Understanding Electricty and Electronics, 4th ed., McGraw-Hill, Unit 9

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
7. solve problems using the variations of the power formula;	Demonstrate a practical application of the power formula. Indicate that P will be expressed in watts, E, in volts, and I, in amperes. Acquaint students with the triangle for the power formula.	TRIANGLE FOR POWER FORMULA 
8. explain the purpose of conductors, semiconductors, and insulators;	Show students conductors, semiconductors, and insulators, and explain their relationship to the flow of electrons. Point out that the energy of moving electrons works machines and that what the electrons do and how they are controlled in a circuit depends mainly upon the materials through which they flow. Indicate that there are certain materials through which electrons cannot flow easily. Emphasize that knowledge of conducting materials helps students to understand the many uses of electrical energy. Have students define conductors, semiconductors, and insulators and list materials used in conductors, semiconductors, and insulators.	Experiences With Electrons, South-Western Publishing, Part II, Unit 1 Electricity and Electronics, Goodheart-Willcox, Chapter 3 Conductors and Insulators (8 mm colour film loops), Prentice-Hall Media CONDUCTOR: A material that can carry electricity SEMICONDUCTOR: A group of solid materials that are good conductors of current under one condition and poor conductors under another

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		INSULATOR: A material that will not conduct current
	Make students aware that even good conductors of electricity have some amount of resistance. Have students mount many different types of wires and cables on a panel and describe the use of each.	Understanding Electricity and Electronics, 4th ed., McGraw-Hill, Unit 25
	Discuss, demonstrate, or have students demonstrate through the medium of experiments these rules of reesistance: . the better the conductor, the less its resistance; . the longer the wire, the more the resistance; . the smaller a wire's diameter, the more its resistance; . the more resistance, the less a current flows.	
	Acquaint students with wire tables and gauges and have them use these to locate information about wires and cables.	
9. describe the use of fuses and circuit breakers.	Discuss and have students define fuses and circuit breakers. Ask students to collect different types of fuses and determine how much current they carry.	Fuses and circuit breakers Experiences With Electrons, South-Western Publishing, Part IX, Unit 5

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Indicate the purpose of a circuit breaker and have students compare the uses and advantages of fuses and circuit breakers.	Electricity and Basic Electronics, Goodheart-Willcox, Chapter 3
C. MEASURING DEVICES The student should be able to:		
1. select meters to measure voltage, current, resistance, and power;	Review the concept that even though electricity cannot be seen, electrical quantities such as voltage, current, resistance, and power can be measured with instruments called meters. Point out that meters such as voltmeters (for measuring voltage), ammeters (for current), ohmmeters (for resistance), multimeters (for voltage, current, and resistance), and watt meters (for power) are used in the designing, manufacturing, servicing, and repairing of all kinds of electrical and electronic products.	Electronic Multimeters: Function and Use (filmstrip, slide set, or video tape), Administration Information Media Educational Aids
2. use meters to measure voltage, current, resistance, and power;	Review and emphasize the requisite safety practices related to measuring procedures. Explain the principle of meter operation. Show students the step-by-step method for reading meters. Have them follow these steps. Emphasize that because meters are delicate instruments, it is important that they be used with care. Discuss the need for reading meters accurately and quickly.	Experiences With Electrons, South-Western Publishing, Part VIII, Units 1, 2, 3, 4, 5, 6, 7, 8 Electricity and Basic Electronics, Goodheart-Willcox, Chapter 8

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Provide students with opportunities to use and read meters.	Current Flow and Measurement, Voltage and Voltage Measurement (8 mm colour film loops), Prentice-Hall Media
	Have students draw diagrams to indicate how a voltmeter is connected to circuit points being tested and how a typical ammeter is connected into a circuit.	
	Have students prepare illustrated reports on how to read meter scales.	
3. explain the purpose of resistance;	Show students examples of resistors. Have them prepare illustrated reports on the use of resistors in household appliances, such as radios, televisions, dimming switches, electric drills, and electric sanders.	Exploratory Electronics Laboratory Model 555 (kit and trainer), Lab Volt RESISTOR: A device that controls the amount of current in a circuit
	Emphasize that resistors limit or impede the flow of electrons through a conductor and that factors affecting resistance include length, diameter, temperature, and type of material.	Experiences With Electrons, South-Western Publishing, Part III, Units 2, 3 Electricity and Basic Electronics, Goodheart-Willcox, Chapter 4 Resistance, Resistance Measurement and Colour Code (8 mm colour film loops), Prentice-Hall Media
4. interpret a resistor colour code;	Point out that some resistors are colour coded with rings or bands to indicate their size. Give students practice in reading the bands in sequential order. Emphasize	RESISTOR COLOUR CODE: A means of identifying the various values of resistors by coding them with coloured rings around the body

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	the importance of being able to interpret colour coding. Have students prepare a resistor colour-code chart.	
5. test/measure various electrical/electronic components.	Discuss the importance of testing various electrical/electronic components, such as capacitors, diodes, resistors, transformers, and transistors. Have students explain the purpose of each component and identify and use the tools and equipment for testing components. Provide students with opportunities to develop troubleshooting skills related to measuring quantities of electricity and electrical/electronic components.	

V. PLANNING AND DESIGN (C.) Estimated Time: 6 hours

MAJOR OBJECTIVE: To develop skills in and to understand the principles of planning and design, and to apply these skills and principles to electricity and electronics.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate planning and design where applicable in other modules in this area of study.	
A. PLANNING FOR ELECTRICITY/ELECTRONICS The student should be able to:		
1. define planning;	Have students discuss and define planning. Point out that the process of planning involves two important resources, people and things, necessary to meet human and business needs.	PLANNING: The process of identifying and preparing details
2. develop an understanding of the importance of planning in electricity/electronics;	Explain the relationship between planning and electricity/electronics. Make students aware that planning is a key element related to managing and completing work projects in electricity/electronics.	Energy: Electricity/Electronics, South-Western Publishing, Chapter 18, pp. 365-366
3. identify the components of planning.	Emphasize that planning for electaricity/electronics is a process of cooperation between people, using resources, equipment, and tools to meet the needs of society, business, and industry.	COMPONENTS OF PLANNING 1. Formulating 2. Researching 3. Designing 4. Engineering

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	List and define the components of planning. Point out their importance to long- and short-term planning.	FORMULATING: The process of deciding what to make to meet needs RESEARCHING: The process of gathering facts to assist with decision-making DESIGNING: The process of developing and creating a plan
	Emphasize that scheduling and coordinating aid in the completion of work and projects in electricity/electronics. Point out that improper planning may result in wasted materials and effort, leading to higher costs.	ENGINEERING: The process of adding details to design and of scheduling for completion
B. DESIGN The student should be able to:		
1. recognize the fundamentals of design;	Review the definition of designing. Point out that while design functions may differ among the various kinds of work and projects in electricity/electronics, certain design principles are constant.	
2. explain the relationship of design to strength, function, materials, cost, and quality;	Make students aware of the influence of design guidelines on the design process. Have students consider the following questions during discussion:	DESIGN GUIDELINES 1. Strength 2. Function

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	a) Strength--Will the design make the product strong and durable? b) Function--Does the design fit the purpose for which it was planned? c) Appearance--Do the parts appear to belong together? d) Materials--Have the materials been used effectively? e) Cost--Does cost relate to strength, function, appearance, materials, and quality of finished work? f) Quality--Is quality an inherent part of the finished work/project? Indicate that these interrelated guidelines are common and necessary to all designs.	3. Appearance 4. Materials 5. Cost 6. Quality
3. Identify the steps in the design process.	Provide students with information about steps pertinent to the design process. Explain the relationship between each of the steps to the development of projects in electricity/electronics. Encourage students to think of projects as design problems and to use plan sheets to answer these questions: a) State the problem--What is the purpose of the project and how will it be used? b) Think through the problem--What are some of the limitations to be considered and in what ways have other people dealt with these?	STEPS IN DESIGN PROCESS 1. Identify problems 2. Apply resources 3. Formulate ideas 4. Record ideas 5. Refine projects 6. Present projects Project plan sheets

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	c) Develop ideas--What types of charts and sketches are needed to portray ideas and determine materials required for their development? d) Prepare flowcharts--What construction steps are necessary? e) Prepare schematic drawings--How should the schematic drawings be developed and prepared? f) Construct the project--How should the schematic drawing be used during construction of the project?	
	Encourage students to compile notebook records of their own ideas and of ideas from other sources. Have students study publications on design to acquire more information about the relationship between products and design. Make students aware that it takes time and practice to acquire the skill and knowledge to solve design problems.	Newspapers, periodicals, and reference books
C. PROJECT CONSTRUCTION The student should be able to:		
1. identify electrical and electronic symbols;	Acquaint students with electrical and electronic symbols. Explain that each electrical/electronic component is represented by a symbol and is connected in a	Chart of electrical and electronic symbols

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	circuit. Encourage students to think of the symbols as they do letters of the alphabet. Point out that schematic diagrams describe only the components and circuitry; they do not show physical or relative sizes of the components, nor how and where the connections are made in the circuitry. Have students practice drawing the schematic symbols.	
2. read blueprints;	Provide students with opportunities to read simple blueprints related to electricity/electronics.	Blueprints
3. read and prepare schematic drawings;	Explain the purpose of schematic drawings and the importance of being able to read and prepare these in electrical and electronic work. Emphasize that schematics are drawn with standard symbols to indicate the requisite components and to illustrate how all the components wiwthin circuits and devices are connected. Have students locate, read, and interpret schematic drawings. Have students prepare schematic drawings for projects.	Schematic drawings Basic Industrial Arts--Electricity, Metalworking, Drafting, Woodworking, McKnight Publishing, Chapter 3, EL-28-EL-35 Experiences With Electrons, South-Western Publishing, Part IV, Unit 1, Part XIII, Unit 1 Electricity and Basic Electronics, Goodheart-Willcox, pp. 286-287 Understanding Electricity and Electronics, 4th ed., McGraw-Hill, Unit 3 Energy: Electricity/Electronics, South-Western Publishing, Chapter 18

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		Electronics: Schematic Symbols (filmstrip, slide set, video tape), Administration Information Media Educational Aids
4. construct and evaluate models and circuits.	Have students use the information on project plan sheets and schematic drawings to construct projects. Encourage students to assess the construction process and the completed product on the basis of planning and design principles and to compare the input components, materials, labour, energy, and other resources to the quality of workmanship and the time and money expended.	

VI. CONSUMERISM (C.) Estimated Time: 3 hours

MAJOR OBJECTIVE: To explore and relate the economic system and er the economy to electricity/electronics and consumawareness.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate instruction, practice, critical thinking, and applications related to the study of consumerism throughout each module in this area of study.	
A. ECONOMIC SYSTEMS AND ELECTRICITY/ELECTRONICS The student should be able to: 1. define economic system;	Explain the term economic system, emphasizing that it refers to the following: . the links between individual workers and managers, productive organizations such as factories or farms, and government agencies, forming a system, a unit, or an organization; . the decision-making process determining what workers, organizations, and government agencies will do to answer basic economic questions facing each nation, province, and local community.	
	List the basic economic questions. Point out how these questions relate, in the area of electricity/electronics, to businesses, services, products, and consumers.	BASIC ECONOMIC QUESTIONS 1. What to produce? 2. How to produce it?

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		3. Who will receive the services and finished products? 4. How much to produce over a period of time?
	Make students aware that political, social, religious, and moral systems influence economic systems and that economic systems change from one country to another and within a single country over a period of time. Point out that by using and consuming resources, the various economic systems produce electrical and electronic goods and services for consumers to purchase. Explain that the following economic activities provide resources for electrical/electronic goods and services: mining, manufacturing, agriculture, and construction. Make students aware of the need for individuals and businesses to choose wisely in selecting goods and services and to use resources effectively during the production of electrical and electronic goods and services.	
2. explain the basic parts of economic systems;	Identify the basics required by economic systems to produce goods and services: inputs, processes, and outputs. Make students aware of the relationship of these basic parts to electricity/electronics	<u>BASIC PARTS OF ECONOMIC SYSTEMS</u> 1. Inputs 2. Processes 3. Outputs

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	businesses, services, and products. Emphasize the following: a) Outputs are goods and services produced by an economic system. b) Processes are work activities required to produce goods and services. c) Inputs are resources required for the work activities to produce goods and services. Have students give examples of outputs, processes, and inputs for work activities related to electricity/electronics services and products.	
3. identify basic types of inputs.	Review the definition of inputs, listing the basic types and emphasizing that they are common to various organizations, such as schools, families, clubs, and businesses. Discuss the relationship among the basic inputs and their application to the production of goods and services for consumption by businesses, organizations, and individuals.	BASIC TYPES OF INPUTS 1. People 2. Knowledge and skills 3. Industrial resources 4. Utilities 5. Finance

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
B. ELECTRICITY/ELECTRONICS AND CONSUMERISM The student should be able to: 1. identify human needs;	Make students aware of the importance of the following human needs: physical, societal, intellectual, and emotional. Relate Maslow's hierarchy of human needs to the services and products of electricity/electronics. Have students identify basic physical, societal, intellectual, and emotional needs. Point out the relationship between these needs and work activities, services, and products pertinent to electricity/electronics.	Looking at the Consumer, Gage Publishing The Confident Consumer, Goodheart-Willcox MASLOW'S HIERARCHY OF HUMAN NEEDS 1. Physical needs 2. Security 3. Love and acceptance 4. Esteem 5. Self-actualization
2. explain how electricity/electronics meets human needs;	Emphasize that electricity/electronics and related services and products are available in different societal and economic systems. Have students compile charts, displays, collages, or illustrated reports about different types of electricity/electronics services and products explaining the need of society, businesses, and individuals for each type. Ask students to explain how the services and products provided by electricity/	Charts Bulletin board displays A Way of Life (16 mm colour film), Film Library, Manitoba Hydro

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	electronics assist society and individuals to meet these basic needs: shelter, food, water, and clothing.	
3. recognize the relationship between electricity/electronics and the economy.	Discuss the importance of various industrial and business activities to national, provincial, regional, and local levels of economy. Have students investigate the effects of industrial and business activities on employment and businesses related to electricity/electronics. Make students aware of the ways industries, businesses, and individuals use the services and products of electricity/electronics to produce other services and goods for consumption by various sectors of the economy.	
C. ELECTRICITY/ELECTRONICS AND THE MARKETPLACE	Point out why prospective users of the services and products of electricity/electronics should develop an understanding of the marketplace and its relationship to the economy.	
The student should be able to:		
1. differentiate between needs and wants;	Have students compile lists of the services and products of electricity/electronics which individuals may desire as opposed to	The World of Business: A Canadian Profile, Wiley Publishers of Canada, Chapter 18

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	need. Make students aware of businesses that need and want the services and products of electricity/electronics.	NEEDS: Things needed by an individual for survival WANTS: Things desired by an individual for pleasure and comfort
2. explain the concepts of quality versus cost and supply and demand;	Discuss the following concepts: quality versus cost, influence of demand on supply nd cost, economic conditions, financing, and advertising. Relate these concepts to the users and producers of electricity/ electronics services and products. Have students discuss and research the following points: . the need to consider alternative products and methods; . the importance and process of comparative shopping; . the evaluation of safety features; . the intensification of energy costs and economic problsms; . the increased need for wise buying and usage practices; . the need to assess dictums such as "always buy the best" which may lead to ineffective use of money; . the need to consider different factors for different products; . the need to develop the habit of asking questions.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Make students aware of the relationship of these concepts to various aspects of electricity/electronics services and products: . planning and design; . human needs; . availability and use of resources; . employment; . availability and choice of various services and products of electricity/electronics.	
3. describe the effects of inflation;	Explain the major causes and effects of inflation, emphasizing the effect of inflation on individuals, industries, and businesses in general and on businesses related to electricity/electronics in particular.	
4. identify the positive and negative aspects of credit buying.	Discuss the direct and indirect costs of credit, and its advantages and disadvantages, to individuals and businesses. Have students compare the costs of items, particularly electrical/electronic items, purchased on cash and credit terms by individuals and businesses.	Looking at the Consumer, Gage Publishing, Chapter 3

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
D. ROLE OF ELECTRICITY/ ELECTRONICS IN CONSUMERISM The student should be able to:		
1. recognize the relationship of energy source to the services and products of electricity/ electronics;	Discuss the relationship of energy sources to the services and products of electricity/electronics and to the industrial, business, and individual consumers of these services and products. Ask students to identify various sources of energy pertinent to the generation of electricity. Have students, individually or in groups, research and prepare charts, scrapbooks, and/or illustrated reports on the generation of electricity from various sources. Discuss the relationship of some of the sources of energy to nuclear power, solar power, and geothermal power.	SOURCES OF ENERGY 1. Natural gas 2. Oil 3. Water 4. Wind 5. Uranium 6. Sun 7. Steam 8. Geothermal steam
2. explain the consequences pertinent to consumption of energy sources;	Have students identify the uses of electricity in homes, farms, businesses, industries, communications, transportation, science, and medicine. Have them discuss the need for continued search and research related to energy sources.	Exploring Power Technology: Basic Fundamentals, Goodheart-Willcox, Units 17, 18, 19, 20, 25, 28 Electricity and Basic Electronics, Goodheart-Willcox, Chapter 2
3. justify energy conservation and cost consideration.	Have students discuss and then demonstrate, through research, experiments, and projects, the importance of conservation and	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	cost consideration in the consumption of energy (particularly energy related to electricity/electronics) by industries, businesses, and individuals.	

VII. COMPONENTS (C.)

Estimated Time: 20 hours

MAJOR OBJECTIVE: To acquire knowledge about components and their importance, and to explore skills, techniques, and applications related to components by building and testing circuits, diagnosing and repairing malfunctions, and constructing electrical/electronic products and projects.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. TYPES AND FUNCTIONS The student should be able to: 1. identify the various types of components;	Point out that electricity/electronics requires many types of components to work effectively, efficiently, and safely. Show students examples and illustrations of the various types of components.	TYPES OF COMPONENTS Breakers Bulbs Buzzers Capacitors Cells, batteries Cords, cables, wires Diodes Electric motors Electromagnets Filters Fuses Generators (AC, DC) Integrated circuits Rectifiers Resistors Sockets, plugs Solenoids, relays Speakers Switches Transformers Transistors Vacuum tubes
2. explain the function(s) of each type of component;	Emphasize that electrical/electronic components have unique physical and electrical characteristics which enable them to perform specific functions.	Experiences With Electrons, South-Western Publishing, Part II, Unit 1; Part III, Units 2, 3; Part VII, Units 1, 2,3; Part IX, Units 4, 5; Part XI, Units 1, 2, 3, 4
3. describe the construction of each type of component.	Help students to recognize and explain the function(s) and construction of various components by involving them in teaching-	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	learning activities like the following: a) Collecting and identifying many kinds of wires, cables, and cords, and mounting them for class exhibition; preparing oral and written reports on the uses of each wire, cable, and cord: and using wire gauges to measure wires, and wire tables to locate specific information about wires. b) Identifying and experimenting with various types of manual on-off switches, electromagnet switches, and transistors to determine how the principle of on-off switching applies to the control of electrical energy. c) Describing operational principles of fuses and circuit breakers as applied to overload control of electrical energy. d) Experimenting with manual switches and diodes to limit the flow of electricity in one direction, or to reverse it; and collecting many types of diodes and recording their peak inverse voltage, forward current, and power rating. e) Experimenting with and reporting about the application of resistors and transformers in controlling the amount of electron flow in a circuit. f) Making a labelled sketch of a simple cell, and collecting pictures of cells	Electricity and Basic Electronics, Goodheart-Willcox, Chapters 3, 4, 16, 17, 18, 19 Experiences With Electrons, South-Western Publishing, Part IX, Unit 5

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	and batteries for display, labelling each as to type and use. g) Collecting several different capacitors, arranging them according to type, recording their capacitance, and measuring their physical size; and demonstrating the basic charging action of a capacitor. h) Disassembling a capacitor. i) Setting up a well-organized display of a variety of transformers and explaining the purpose and operation of each; listening to speakers, from Manitoba Hydro or an electrical firm, explaining how transformers are used in a distribution system; and disassembling an old transformer, and then labelling its parts. j) Preparing an illustrated report on the use of resistors in common household appliances and devices, and developing displays or charts of various resistors and their schematic symbols. k) Using library resources to prepare a report on the uses of a generator. l) Collecting and displaying several transistors, to determine some of these common specifications: type, material, current gain, and voltage, power, and current rating. m) Reporting on the use of electromagnetism and electromagnetic devices; and experimenting with electromagnetism to learn about the operation of door	The Basic Book of Electricity and Electronics, American Technical Society, Unit 24 Experiences With Electrons, South-Western Publishing, Part VII, Unit 2 Electricity and Basic Electronics, Goodheart-Willcox, pp. 164-169 The Basic Book of Electricity and Electronics, American Technical Society, Unit 26 The Generator and the Motor (colour film), Manitoba Hydro Experiences With Electrons, South-Western Publishing, Part XI, Unit 3 The Basic Book of Electricity and Electronics, American Technical Society, Unit 19

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	chimes, bells, buzzers, and relays. n) Describing the characteristics of different kinds and sizes of dry cells; preparing a large, labelled sketch of a simple cell; and collecting cells and batteries for a display, labelling each as to type and use. o) Preparing a poster-size chart of the common electronic components, their schematic symbols, and their uses in circuits. p) Explaining the use of components in microcomputers and computer-related devices; discussing printed circuit techniques and emphasizing the difference between microprocessors and microcomputers. Point out that microprocessors are individual, printed--or integrated--circuit chips, and that they perform specific processing functions, such as arithmetic, memory, and logic functions. Point out, too, that microcomputers are systems built around microprocessors and other printed circuits to handle complete data or word processing jobs. Show students examples of circuit boards and single microprocessor chips. Mention the use of microcprocessor chips in automobiles to control fuel mixtures and to monitor engine temperatures. Have students identify the use of chips in electronic calculators.	Electricity and Basic Electronics, Goodheart-Willcox Company, pp. 286-287 Experiences With Electrons, South-Western Publishing, Part XIII, Unit 1 The Basic Book of Electricity and Electronics, American Technical Society, Units 29, 30, 31 Experiences With Electrons, South-Western Publishing, Part XI, Unit 4; Part XII, Units 1, 2

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
B. APPLICATIONS OF COMPONENTS		
	Inform students that in relation to this application phase of components, the class will spend some time researching, experimenting, reading diagrams and directions, and constructing in order to develop an understanding of electricity/electronics. Emphasize safety precautions, the need to follow step-by-step procedures, and correct and careful use of tools and materials to achieve high quality workmanship and avoid waste.	Electric Engraver Project, Transformer Project, Photoelectric Projects, Shimmerlight Projects, Electronic Siren Project, Organ Project (kits), Cam-Gard Supply Battery Checker Project, 6 and 9 Volt Power Supply Project, 500 Continuity Checker Project (kits), Graymark International Exploratory Electronics Labortory Model 555, Introduction to Electricity and Electronics Model 506, Lab Volt
The student should be able to:		
1. construct components;	Have students construct simple components, such as switches and transformers.	Project Transformer (colour film), Manitoba Hydro
2. build and test circuits;	Discuss the relationship of circuit diagrams to the building and testing of circuits. Ask students to procure and study circuit diagrams of some electrical/electronic devices, identifying the components and loads specified in the diagrams. Discuss the basic parts of circuits.	ELECTRICAL/ELECTRONIC DEVICES 1. Radio 2. Television 3. Clothes dryer 4. Microcomputer

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Encourage students to read, use, and prepare schematic diagrams in the construction of circuits. Have students follow step-by-step procedures in building and testing circuits.	
	Encourage students to describe the structures and functions of and draw the symbols for these digital computer circuits: AND, OR, NOT, NAND, and NOR.	Experiences With Electrons, South-Western Publishing, Part XII, Units 1, 2
3. diagnose and repair electrical/ electronic malfunctions;	Emphasize that repair jobs require knowledge of theory, components, materials, tools, test instruments, and testing methods, as well as ability to recognize symptoms of defective devices or circuits. Have students form a plan of action to repair a defective device. Demonstrate and then have students use correct procedures for diagnosing, repairing, and testing a device, an appliance, or an electronic circuit. Have them complete reports on repair jobs.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES

REPORT ON REPAIR JOB

Name _____ Date _____

Product Or Circuit Worked On _____

_____

For Whom This Job Was Done _____

_____

Description Of Defect Or defects _____

_____

_____

_____

General Procedures Used In Doing The Job _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Tools/Instruments/Components Used _____

_____

_____

_____

Time Spent In Doing The Job _____

Approved Yes _____ No _____

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
4. produce electrical/ electronic products/projects.	Review principles of planning and design, the meaning of schematic symbols, and the reading and preparing of schematic drawings. Emphasize that advance planning is a valuable beginning step for these reasons: it provides a chance to prepare for work to be done; it determines what components, equipment, and tools are required; it identifies potential problems and related solutions; and it saves time. Discuss the form, content, and importance of plan sheets for projects/products, and have students use them. Point out that plan sheets outline steps to follow in planning for and in completing projects. Have students use project kits and/or plan and develop their own projects/products, complete with schematic diagrams. Have them demonstrate and describe special features of their projects, explain the electrical/electronic theory related to the projects, and organize and participate in project fairs.	Experiences With Electrons, South-Western Publishing, Part XIV, pp. 234-269 Electricity and Basic Electronics, Goodheart-Willcox, p. 6

VIII. TOOLS AND FASTENERS (C.) Estimated Time: 6 hours

MAJOR OBJECTIVE: To develop knowledge about and skill in the use of hand tools, power tools, meters and fasteners, and to apply this knowledge and skill to electricity/electronics.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Refer to Power Energy for Module VII, Tools and Faskteners. Encourage students to acquire an understanding of the tools and fasteners applicable to electricity/electronics through participation in experiences such as: . completing a tool identification sheet, . using a tool application sheet, . using various scales for standard and metric measurements, . using voltmeters and ohmmeters to measure electricity; . tightening and loosening bolts with various types of wrenches, . soldering two components together and/or welding two pieces of metal together, . using a solderless connector to fasten two lengths of wire together.	Industrial Arts 7-9: Power/Energy (Power/Energy), Module VII, Tools and Fasteners The Basic Book of Electricity and Electronics, American Technical Society, Unit 3 Electronics: A Practical Introduction, SI metric, John Wiley and Sons, Chapters 2, 6, 9, 11 Experiences With Electrons, South-Western Publishing, Part XIII, Unit 2 The Basic Book of Electricity and Electronics, American Technical Society, Unit 2 Experiences With Electrons, South-Western Publishing, Part XIII, Units 3, 4, 5

IX. ENERGY SOURCES (C.) Estimated Time: 10 hours

MAJOR OBJECTIVE: To recognize the significance of energy sources in the development of civilizations, and to gain information about major and alternate sources of energy, the factors influencing their supply and use, and the need for energy conservation.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Make students aware that throughout history, people have done their work using sources of energy developed by individuals, industry, and society.	
A. SOURCES OF ENERGY SUPPLY The student should be able to:		
1. recognize the importance of energy supply;	Point out that modern civilization has developed because various sources of energy have added to the muscle power of individuals. Make students aware that sources of energy have helped to produce goods and new means of transportation and communication. Emphasize that energy supply is the total quantity of usable energy, and that it functions in these ways: to do work, to provide warmth, to move people and goods, and to operate various appliances.	
2. collect information about the early sources of energy;	Identify some uses of early energy sources: human and animal muscles used to complete work; fire, to provide warmth; simple machines (axe, inclined plane,	"Energy," The World Book Encyclopedia, Volume 6, 1981

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	pulley, screw, lever, wedge, wheel, and axle) to assist with work; wind, to move boats; flowing streams, to grind flour; and steam, to operate factory machinery and to speed land and ocean transportation. Interest students in individual and group learning experiences, all of which emphasize important early developments in the harnessing of energy sources: . preparation of posters, models, collages, and timelines related to early sources of energy; . writing of themes or term papers on topics pertinent to early sources of energy; . collection of data from references for preparation of oral reports and dramatizations; . performance of demonstrations and experiments illustrating mechanical advantages and disadvantages of simple machines; . construction of a small steam engine model of a water wheel, operated by the force of a garden hose or faucet.	Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Sections 1-5
3. identify major sources of energy;	Emphasize that a large percentage of the world's energy supply comes from burning fossil fuels such as coal, petroleum, natural gas and a small percentage from nuclear fission and waterpower. Interest students in a variety of activities in which they can determine the supply, uses,	Manitoba Resources: Electricity, Energy Realities, The Nuclear Age, Power from the Atom, Progress in Power, Nuclear Fuel Waste Management (colour films), Manitoba Hydro

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	advantages and disadvantages of each major energy source: . reading maps indicating where major energy sources are in Manitoba, Canada, North America, and the world; . clipping newspaper and periodical articles about developments related to the main sources of energy; . drawing graphs portraying the total amount of energy available in the world and in Canada from known reserves of coal, petroleum, natural gas, nuclear-uranium; . making pictures, models, and/or displays of coal mines, oil wells, and atomic energy plants; . constructing CO_2 cars and model rockets.	Power Mechanics of Energy Control, McKnight Publishing, Chapter 7 Energy and Matter, Wind (films), Manitoba Department of Education Harness the Wind, Sun, Wind, and Wood (films), National Film Board
4. describe alternate sources of energy.	Point out that these sources of energy are either not used or used in a limited way: geothermal energy, solar energy, wind energy, nuclear fusion, garbage power, tidal power, and ocean thermal energy conversion. Have students prepare brief descriptions of the alternate sources of energy, locating geothermal fields and coastal areas with high tides on maps. Have them develop illustrated reports or displays on alternate sources of energy and their potential uses. Acquaint students with and have	Energy Alternatives, Energy Alternatives II, Fusion Energy Hope for the Future (colour filmstrips, cassettes, study guides), McIntyre Educational Media Power: Mechanics of Energy, McKnight Publishing, Chapter 10 Energy Seekers (16 mm colour film and guide), Library, Manitoba Department of Education

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	them research magneto hydrodynamics, thermionic generators, thermoelectric generators, and tubular generators.	NEW SOURCES OF ELECTRICAL ENERGY 1. Magneto hydrodynamics: Electrical energy source involving magnetism and a moving gas 2. Thermionic Generators: Space-power generation; when a metal is heated, electrons become excited and leave its surface 3. Thermoelectric Generators: A circuit containing wires of two different metals, with the wire joints kept at two different temperatures 4. Tubular Generators: Heat is supplied by strontium 90
B. USES OF ENERGY SOURCES The student should be able to: 1. explain the factors related to the supply and use of energy sources;	Point out that major energy sources such as coal, petroleum, natural gas, and water power produce electricity, which runs machines, heats and cools buildings, and does many other jobs for individuals, industries, and society. Emphasize that several factors determine energy supply and consumption, and that	Newspapers, periodicals Energy Dilemma, Energy for the Future, Energy from the Sun, Energy A Matter of Choices, Energy: The Fuels and Man, Energy: The Problems and the Future (16 mm colour films), Library, Manitoba Department of Education

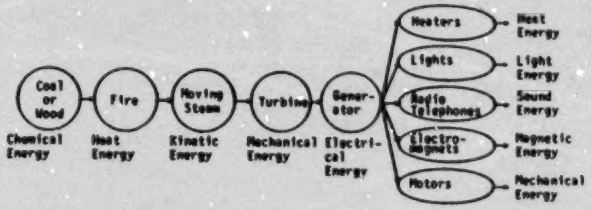
TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	often one factor influences another. Encourage students to discuss or prepare reports on these factors and related concepts: a) Availability--How does the tendency of people to use sources of energy that are plentiful and easily obtainable pertain to all sources of energy? b) Economics--How does the fact that materials are inexpensive when they are in large supply and heavy demand pertain to all sources of energy? c) Politics--How are all sources of energy affected by the fact that money used to study energy sources may come from government, that government laws influence how people and industries use energy, and that local groups exert political pressure on various levels of government? d) Environmental issues--What effects on the environment are related to coal mining, to exploration for and transportation of oil, to the burning of coal, petroleum, and natural gas, and to the radioactive wastes from nuclear fusion?	FACTORS DETERMINING ENERGY SUPPLY 1. Availability 2. Economics 3. Politics 4. Environmental issues Critical Issues in Science and Society: The Great Energy Debate Parts I and II, Energy-Crisis and Resolution, The Solar Quest, Energy, Energy Management for the Future (kits), Library, Manitoba Department of Education Newspapers Periodicals Radio and television news

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. recognize the importance of energy conservation.	Discuss these concerns and concepts: a) Energy supply is a field of rapid change. b) Energy use increases rapidly as populations grow. c) Rate of energy use per individual grows as living standards rise. d) The significance of renewable and non-renewable resources must be recognized. e) New predictions of available supplies and of probable demands are continually made. f) New ideas for developing alternate sources are continually proposed. g) Production of energy adds to environmental pollution. h) A variety of energy sources will be used in the future; e.g., wind, coal, and petroleum may be the primary energy sources in some places, while tidal power may dominate in coastal regions. Emphasize that conservation of energy will demand new habits and attitudes from government, industry, and every individual. Ask students to prepare reports, experiments, and/or displays showing methods of energy conservation pertaining to heating, appliances, and transportation.	Energy Realities (colour film), Manitoba Hydro Energy Management for the Future (16 mm colour film), Library, Manitoba Department of Education The World Book Encyclopedia, Volume 6, pp. 226a - 226f The New Book of Knowledge, Volume 5, Grolier, pp. 202a - 203.

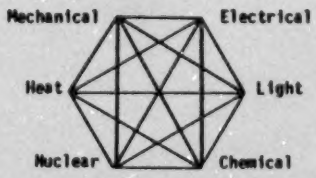
X. ENERGY CONVERSION (C.) Estimated Time: 10 hours

MAJOR OBJECTIVE: To gain an understanding of the principles of energy conversion, to recognize the uses and relationships of the forms of energy, and to apply information about methods of producing electrity from other forms of energy to electricity/electronics projects and products.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. PRINCIPLES OF ENERGY CONVERSION The student should be able to: 1. recognize the importance of energy;	Emphasize energy's importance by having students prepare lists, diagrams and/or displays and perform experiments relevant to these concepts: a) Energy is necessary for getting a job done. b) Energy causes things to happen. c) Energy is the capacity or ability to do work. d) Power, light, sound, motion, heat, and life depend on energy. e) Energy exists in many forms. f) All forms of energy are related. g) The sun is the source of all energy. h) The progress of civilization can be traced by the success of individuals/industries/societies in controlling energy.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. define energy conversion; 3. explain the process of energy conversion.	Discuss and have students define energy conversion. Ask them to give examples of energy conversion to support the definition. Emphasize that according to the Law of Conservation of Energy, energy cannot be created or destroyed, but can be changed into different forms such as light, sound, heat, motion, and electricity. Explain that no energy conversion process is perfect and that whenever energy is changed from one form to another, some is lost.  	ENERGY CONVERSION: The changing of energy from one state/form to another

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Prepare a transparency and/or have the students develop charts or bulletin board displays related to the above diagram to emphasize that energy exists in many forms, that in all the conversions no new energy is produced, and that energy comes from coal or wood, which in turn owe their origin to the sun. Point out that to harness energy for work, it must be changed from natural forms into other forms. Involve students in these teaching-learning activities, which clarify the importance of the energy conversion process: . presentation of illustrated reports and demonstrations of the use of windpower to generate mechanical energy, windpower to generate electrical energy, etc.; . participation in teacher-directed study of the conversion of water to mechanical energy to electrical energy; . development of projects or experiments to illustrate the operating principles of converting mechanical energy to electrical energy and vice-versa; . demonstration of the operating principles pertinent to converting chemical energy to electrical energy; . preparation of projects or experiments related to the conversion of alternating current to direct current; . discussion of geothermal, nuclear, and solar energy and the conversion of each	New Windmill Design (film), National Research Council Brace Institute Windmills (film), Brace Research Institute Electricity/Energy (video recording), Library, Manitoba Department of Education The Burning Problem (film), Biomass Energy Institute Solar Water Heating (film), Brace Research Institute Solar Energy: To Capture the Power of the Sun and Tide (film), International Telefilm Enterprises

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	to electrical energy; . demonstration of storage of electrical energy in batteries as chemical energy.	Putting the Sun to Work (film), City Films
B. CONVERSION OF ENERGY FORMS The student should be able to: 1. identify the forms of energy;	Emphasize that energy is constantly present in three forms: motion, heat, and light. Indicate that the technical name for motion is mechanical energy. Point out that energy may be available in three other forms: chemical, nuclear, and electrical. By means of diagrams, experiments, and projects show students that the six forms of energy are all related and that one form can be converted into another.  	ENERGY FORMS 1. Motion (mechanical) 2. Heat 3. Light 4. Chemical 5. Nuclear 6. Electrical

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Make students aware of these facets of energy conversion: a) Some conversions, such as fire changing chemical energy into heat and light energy, are easy. b) Some conversions, such as light being changed to nuclear energy under strict laboratory control and in very small amounts, are difficult.	
2. recognize the importance and uses of various energy forms;	Provide examples to explain the importance of various uses of the energy forms. Have students discuss the following concepts and uses of the different energy forms: a) Mechanical energy exists in every moving object--in a hammer driving a nail, a leaf or rock falling on the ground, an automobile being driven along the highway, a rocket or airplane flying into space. Ask students to identify other examples of mechanical energy. b) Heat energy is a common form of energy continually used to develop mechanical energy--to cook food, to move an automobile, to generate steam for the production of electricity, and to grow and keep plants alive. Encourage students to provide other examples the use of heat energy. c) Light energy permeates the universe through the sun and the stars and promotes the life of plants and	Power: Mechanics of Energy Control, McKnight Publishing, Chapter 1

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	animals and makes things visible. Ask students to explain radiant energy, its relationship to heat and light energy, and the way in which the earth acts as as receiver and transmitter of radiant energy.	RADIANT ENERGY: Heat and light energy
	d) Chemical energy is often defined as the energy of life--plants use the sun's energy, carbon dioxide, water, and minerals to change radiant energy into chemical energy, which, when stored in plants, can be converted into heat and light (radiant energy) through the process of burning. Ask students to list the various types of chemical energy developed by people).	
	e) Nuclear energy, produced by changing matter into energy by the interaction of hydrogen and uranium, transforms part of the centre or the nucleus of each atom into energy, causing small amounts of matter to produce tremendous amounts of energy. Have students research the uses of nuclear energy and explain the difference between fission and fusion as they pertain to nuclear energy).	Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Chapter 11
	f) Electrical energy, resulting from the motion of electrons, is a flexible and easily transportable form of energy used for lighting electrical lamps, operating magnets, and communicating by way of radio, television, and computers.	ELECTRONS: Invisible particles of matter

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Ask students to list the many uses of electrical energy. Have students work on these projects related to the uses of various energy forms: . preparing posters, displays, and illustrated reports, . conducting and reporting findings.	
C. ELECTRICITY AND ENERGY CONVERSION	Review the definitions of electrons, electricity, and electronics and the relationship of energy conversion to the types and uses of various energy forms. Emphasize that electricity is produced through conversion of forms of energy. Explain tht electricity is produced when a difference of potential is developed; that is, when there is an excess of electrons at one point in a circuit and a lack of electrons another. Point out that electricity can be converted into other forms of energy.	ELECTRICITY: A field of study relating to circuit systems in which electrons flow primarily through solid-wire conductors of various forms ELECTRONICS: A field of study relating to circuit systems in which electron tubes and solid state devices such as diodes and transistors control the flow of electrons

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
The student should be able to:		
1. identify the forms of energy used to generate electrical energy;	Have students idenify forms of energy used to generate electrical energy: friction, heat, light, pressure, chemical action, magnetism.	Electricity Produced by Friction; Electricity Produced by Pressure, Heat, and Light; Electricity Produced by Chemical Action - Part I and Part II; Electricity Produced by Magnetism - Part I and Part II (Super 8 mm colour film loops), Prentice Hall Media
2. explain the methods of producing electricity from other forms of energy.	Acquaint students with the various methods of producing electricity and the devices related to the production processes by having them discuss the following tabulation.	Electricity and Basic Electronics, Goodheart-Willcox, Chapter 2
		Experiences With Electrons, South-Western Publishing, Part II, Unit 2
		Basic Industrial Arts--Woodworking, Drafting, Metalworking, Electricity, McKnight Publishing, Chapter 1, EL 1

WAYS OF PRODUCING ENERGY

METHOD	DEVICE
1. Friction	Electrostatic devices
2. Heat	Thermocouple
3. Light	Photocell or solar cell
4. Pressure	Crystal microphone and crystal photograph cartridge
5. Chemistry	Cells and batteries

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Involve students in these activities to develop their knowledge of the energy conversion theory and processes and the application of energy conversion to the production of electricity:	
	a) Friction--Discussions, reports, displays, posters, and experiments pertinent to the theory of electrical charges, the creation of static electricity by lightning and by individuals, the practical uses of static electricity (such as electrostatic spray painting, electrostatic manufacture of sandpaper, electrostatic precipitation, and electrostatic photocopying), and the work of Thales and Van de Graaff.	Electricity Produced by Friction (8 mm colour film loop), Prentice-Hall Media
	b) Heat--Collection of information for term papers, posters, and experiments related to the theory of thermoelectricity, and to the definition, basic theory, construction and uses of thermocouples; construction of thermocouples from different types of wire to record and report the voltage produced from each.	Electricity Produced by Pressure, Heat, and Light (8 mm colour film loop), Prentice-Hall Media THERMOCOUPLE: Device made of two different kinds of metal joined at one end, which, when heated at the junction, generates an electromotive force across the open end
	c) Light--Collection of information about the principle of operation, the construction, and the uses of solar cells, and the uses of solar cells in photography and satellites; experimentation showing how solar cells produce electricity, and construction of projects	SOLAR CELL: Cell that turns light energy into electrical energy

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	such as fibre optic lamps, and light control switches. d) Pressure--Definition of piezoelectricity, emphasizing that certain crystals such as quartz produce electrical voltage when pressed and released; discussion and demonstration of the process of creating piezoelectricity by placing a quartz crystal between two metal plates, applying pressure to produce an electron flow, and measuring the electromotive force generated when pressure exerted on crystalline materials bends or distorts them, and the electrons are forced to move; preparation of illustrated reports on the use of piezoelectricity in sound equipment, telephones, hospital equipment for measuring various body pressures, "tuning fork" wristwatches, and quartz clocks; e) Chemical Action--Discussion of the creation of electricity from chemical energy, tracing its historical development by collecting informaton about the scientific research of Alessandro Volta and by building and testing a model of Volta's cell, which consists of ascetic acid (vinegar), electrodes of copper and zinc strips, a container, and measuring device (Volta used his cell to prove that when two dissimilar elements were placed in a chemical which acted upon them, an electrical potential was	PIEZOELECTRICITY: Electricity produced by applying pressure to a crystal or to crystalline materials QUARTZ: A crystal which can produce electricity Electricity Produced by Chemical Action, Part I and Part II (colour film loops), Prentice-Hall Media Electronics: A Practical Approach, SI metric, John Wiley and Sons, Chapter 13

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	built between them); preparation of reports based on these projects: . constructing a voltaic cell by cuting a one-inch square of blotting paper and soaking it in a strong salt solution, placing the wet blotting paper between a penny and a nickel, and connecting the coins to a meter to determine the amount of electromotive force generated by the chemical action; identifying the positive and negative poles of this simple battery; . constructing a battery by inserting electrodes into a grapefruit, lemon, or tomato, and measuring between the electrodes the voltage developed; determining if moving the electrodes closer together or farther apart affects the voltage output; identifying the positive and negative electrodes; . constructing a demonstration model of a voltaic cell (emphasizing safety precautions), using a diluted solution of sulphuric acid for the electrolyte, measuring the current output with copper and zinc electrodes, and repeating the experiment substituting aluminum, iron, brass, and lead first for the zinc and then for the copper electrode; considering which combina-	Basic Industrial Arts-Electricity, McKnight Publishing, pp. EL-14, EL-15

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	tions of metals produce the greatest power and whether the various metals affect the direction of current flow; . comparing primary and secondary cells as to their definitions, construction (including a description of the materials used), principles of operation, uses, and length of life; collecting, building, and labelling a display of various types of batteries;	Cells and batteries
	f) Magentism--Preparation of records on the scientific experimentation conducted by Michael Faraday and Joseph Henry; demonstration and discussion of the relationship among magnets, magnetism, and electromagnetism; experimentation using a galvanometer, a coil of wire, and a bar magnet to demonstrate the conversion of magnetism to elecatricity and to record the effects of these variations: . changing the size of the magnet; . using coils with different numbers of copper wire turns; . using different sizes of wire; . changing the speed with which the magnet is moved into the coil.	Experiences With Electrons, South-Western Publishing, pp. 25-27 Electricity and Basic Electronics, Goodheart-Willcox, pp. 24-32 Electricity Produced by Magnetism, Part I and Part II, Electromagnetism (colour film loops), Prentice-Hall Determining the Effects of Electrical Current (colour filstrips, cassettes, workbook/study guide), Prentice-Hall Media MAGNET: A substance, such as iron or steel, which attracts magnetic material MAGNETISM: The invisible force that attracts certain materials such as steel

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		ELECTROMAGNETISM: Magnetism produced by current flowing through a coil of wire or other conductor
		Galvanometer Coil of wire Bar magnet
		Electromagnets: How They Work, Electromagnets and Their Uses (16 mm colour films), Library, Manitoba Department of Education
		Electronics: A Practical Introduction, SI metric, John Wiley and Sons, Chapter 15
	Discuss the principle of electromagnetism as it applies to generators. Ask students to prepare a report and a display of the actual use in home and school of the principle of producing electricity by means of magnetism.	Exploring Electricity/Electronics With the Electrical Team, Delmar Publishers, Project H, pp. 167-168
	Encourage students to experiment with electromagnetism to gain an understanding of the basic operating principles of simple electric motors, door chimes, bells, buzzers, and relays.	Exploring Electricity/Electronics With the Electrical Team, Delmar Publishers, Project G, pp. 164-166

XI. ENERGY TRANSMISSION (C.) Estimated Time: 15 hours

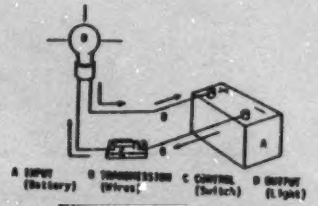
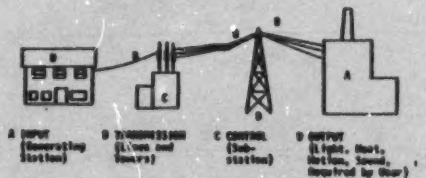
MAJOR OBJECTIVE: To obtain knowledge about energy transmission and various types of circuits, to recognize the relationship of input, control, transmission, output, and various devices to the transmission process, and to apply this process to communication devices.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. INTRODUCTION TO ENERGY TRANSMISSION The student should be able to:		
1. define energy transmission;	Discuss and have students define energy transmission.	ENERGY TRANSMISSION: Movement of energy from the point at which it is generated to the point at which it is used.
2. recognize the importance of energy transmission.	Emphasize that electricity is useless if not transmitted. Point out that unlike other products, electricity cannot be stored but can be generated as required. Discuss and illustrate these examples: a light, when turned on, uses electricity produced an instant before; cells and batteries, rather than storing electricity, convert chemical to electrical energy immediately before it is required. Refer to the use of cells and batteries in flashlights and cars.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
B. ELECTRICAL CIRCUITS The student should be able to:		
1. define a circuit;	Discuss and ask students to define a circuit. Emphasize that an electric circuit is a combination of parts connected to form a complete path through which electrons can move and that a circuit uses the energy of moving electrons.	CIRCUIT: An electrical path having a power source, a load, and conductors to carry current OR A system of parts, or components, by which electric energy can be changed into heat, light, magnetism, motion, and sound
2. identify the basic parts of a simple circuit;	Show students a simple circuit and have them identify these basic parts: power supply, conducting device, consuming device, and controlling device. Explain these principles: a) The power supply furnishing electrical energy can be a single cell, a battery, or 120 volts from a wall outlet. b) The conducting device providing the path for the movement of electrons can be a wire, bar, or channel. c) The consuming device using electrical energy (such as a light bulb, a toaster, an electric motor, or a radio) produces light, heat, motion, and sound.	BASIC PARTS OF A SIMPLE CIRCUIT 1. Power supply 2. Conducting device 3. Consuming device 4. Controlling device Electronics: A Practical Introduction, SI metric, John Wiley and Sons, Chapter 14 Series Circuits, Parallel Circuits, Complex Circuits (colour filmstrips, cassettes), McIntyre Educational Media

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	d) The controlling device regulating the flow of electrons in a circuit can be a switch, an electromagnetic relay, a diode, a transistor, or electron tubes.	
3. draw a simple circuit;	Review the symbols required for schematic drawings of simple circuits. Draw a simple circuit, step-by-step, having students follow the procedure to complete their own drawings.	
4. construct a simple circuit;	Have students follow their schematic drawings to construct simple circuits consisting of a power supply, a wire, a switch, and a light bulb.	
5. describe the application of complete circuits, closed and open circuits, short circuits, series circuits, parallel circuits, and series-parallel circuits to energy transmission;	Have students use schematic drawings, demonstrations, models, and experiments to identify and compare the various types of circuits, their components, construction, uses, and principles of operation.	Series Circuits, Parallel Circuits, Complex Circuits (colour filmstrips, cassettes), McIntyre Educational Media
6. construct complete, open and closed, series, parallel, and series-parallel circuits.	Ask students to explain the relationship of power supply, conducting devices, consuming devices, and controlling devices to energy transmission in each type of circuit.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
C. TRANSMISSION OF ELECTRICITY The student should be able to: 1. identify the four units in the transmission cycle for electricity;	Review the definition of energy transmission. Show students, by way of illustrations and audio-visual media, the four units in the electrical transmission cycle from a cell and from a generating station.	UNITS IN THE ELECTRICAL TRANSMISSION CYCLE 1. Input 2. Control 3. Transmission 4. Output
2. recognize the importance of input, control, transmission, and output to the electrical energy transmission process.	Have students discuss the following diagrams and prepare posters, charts, displays, and illustrated reports explaining the importance of input, control, transmission, and output to the electrical energy transmission process. TRANSMISSION OF ENERGY IN A SIMPLE CIRCUIT	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		
		

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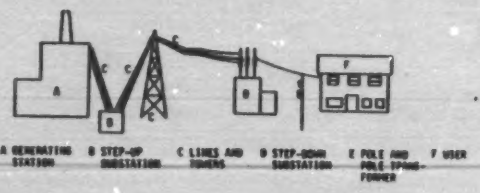
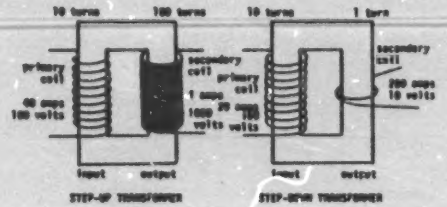
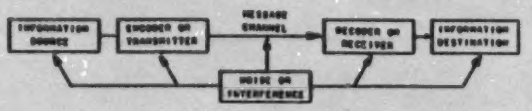
TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. describe the principles governing the application of direct and alternating current to the transmission of electricity;	Review the definitions of direct and alternating current. Point out that in the transmission process, electrical current travels at the speed of light at the rate of 186 000 miles (299 274 kilometres) per second, or the equivalent of eight times around the world in one second. Demonstrate these principles of direct and alternating current applied to the transmission of electrical energy: a) Direct current, often called DC, flows only in one direction. b) Direct current moves from negative to positive. c) Batteries and cells produce direct current by chemical action. d) Generators produce direct current by mechanical action. e) Alternating current, often called AC, changes direction. f) Alternating current moves first in one direction and then in another. g) The term frequency indicates how often alternating current changes direction. h) Alternating current changes direction 120 times per second, moving back and forth 60 times per second. i) Generators producing alternating current are called alternators. Have students report on the work of Thomas Edison in determining the principles and	Basic Electricity and Electronics: Direct Current, Basic Electricity and Electronics: Alternating Current (colour filmstrips, cassettes, study guide), McIntyre Educational Media Experiences With Electrons, South-Western Publishing, Part VI

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	applications of direct current and the work of Nicholas Tesla and George Westinghouse in determining the principles and applications of alternating current.	
4. explain the use of transformers in the transmission of electricity;	Review the concept that electrical energy, once generated, is often transmitted a long distance to users. Point out that electrical energy is transmitted at high voltages to make it available to users spread over wide areas; that transformers change the voltage and current to more usable forms; and that transformers transfer electrical energy from one circuit to another. Emphasize that transformers do not produce electrical energy. Explain that transformers in substations and other locations transmit vast amounts of electricity over great distances and serve it to consumers in small portions. Using the following illustration, or one similar, point out that the generators at station A produce power at 13 800 volts; the voltage is stepped up to 230 000 volts at step-up substation B for transmission by way of lines and tower C; the voltage is stepped down to 115 000 volts at step-down substation D to supply various substations; at these substations, the voltage is reduced to 24 000 volts to supply smaller substations, where the voltage is further reduced to feed specific areas; from pole-	Experiences With Electrons, South-Wetern Publishing, Part VII, Unit 2 Electricity and Basic Electronics, Goodheart-Willcox, Chapter 11, pp. 164-169

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	mounted transformers the voltage is stepped down to only 120 volts to enter the average home; and inside the home, another transformer drops the voltage to a mere 6 volts to operate the door chimes.	
		
	Have students prepare posters and accompanying reports to show the transmission of electricity in their localities.	
5. describe the operation of step-up and step-down transformers.	Demonstrte these concepts: a) A transformer has two coils, primary and secondary. b) The primary coil is the input side and the secondary coil, the output side. c) The two coils are not connected. d) The operation of a transformer is dependent upon a constantly changing	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	current such as an alternating current or a pulsating direct current. e) The voltage produced by the secondary coil depends on the number of turns of wire it has compared with the number of turns of the primary coil. Ask students to study these diagrams to define step-up and step-down transformers and to explain the operation of each. 	STEP-UP TRANSFORMER: A transformer that steps up the voltage from the primary coil to the secondary coil STEP-DOWN TRANSFORMER: A transformer that steps down the voltage from the primary coil to the secondary coil

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Point out that in step-up transformers, input is lower than output voltage, and that in step-down transformers, input is higher than output voltage. Emphasize that voltage produced by the secondary coil depends upon the number of turns of the primary coil, that if 100 volts are applied to the primary coil in a step-down transformer, the secondary coil would produce 10 volts, and that if 100 volts are applied to the primary coil in a step-up transformer, the secondary coil would produce 1000 volts. Demonstrate and then have students explain the procedures for using or constructing simple step-up and step-down transformers, and for measuring and comparing their input and output.	
D. TRANSMISSION AND COMMUNICATIONS The students should be able to: 1. identify the communication devices dependent upon electrical energy and electronic signals;	Hold brainstorming sessions about these concepts related to communiction and communication devices: a) The human race has communicated in various ways for thousands of years.	COMMUNICATION DEVICES Citizen band radios Electronic typewriters Facsimile machines Laser

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	b) Communication dependent upon electrical energy and electronic signals has been possible only in the last century. c) Communication between people, people and machines, and machines and machines is possible through electronic means such as computers. Have students, individually and in groups, prepare posters, collages, displays, and reports on the various communication devices dependent on electrical energy and electronic signals.	Microcomputers Microwave towers Radar Radios Satellites Telegraphs Telephones Televisions Video disc plyers Video display terminals Video tape recorders
2. explain the communication/transmission process pertinent to communiation devices;	Digaram and have students discuss this basic communication/transmission model:  Relate these steps in the communication/ transmission process to various communication devices: a) An information source is the origin of the information to be communicated. b) The encoder or transmitter converts or changes the informtion to electrical/	Experiences With Electrons, South-Western Publishing, Part X, Units 1, 2, 3, 4, 5, 6, 7, 8

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	electronic signals. c) The information travels along some channel which may be electromagnetic waves, wires, air, or some other medium. d) The message is picked up by a decoder or receiver and converted to a form such as sound, picture, or print (electronic mail). e) The message reaches its destination, a person or a machine. f) The message may be interrupted by noise or another form of interference.	
3. describe the purposes and uses of frequencies in the communication/transmission process;	Discuss the purposes of power, audio, radio, and television frequencies pertaining to various communication processes and devices. Make students aware that limited frequency locations are available, that they are assigned to satisfy the needs of many people for many purposes, that they are located to minimize interference between the various services, and that locations of various communication services are given on a frequency spectrum chart. Have students learn about frequencies by participating in some of these teaching/learning experiences: . using the frequency spectrum chart to identify frequency locations of several communication services related to AM, FM,	Frequency spectrum chart

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	citizens band, and amateur radio, to television, to police, fire, mobile, sea, and air communication devices, and to electronic mail; . listing some of the frequencies used by radio stations; . identifying the frequencies used by local television stations; . considering why television frequencies are different from those of radio; . following operating instructions for walkie-talkie receivers (not requiring licenced operation) to determine the largest operating range and the effect of buildings, hills, and vehicles on operation; . building and using an FM minibroadcaster; . preparing scrapbooks and illustrated oral and written reports on radar communiction/transmission systems, weather satellites, the use of laser for transmitting communications, and electronic mail.	
4. explain the relationship of the federal Department of Communiction to communication transmission.	Point out the need to control the use of space in the transmission of communications. Explain that the federal Department of Communication and its related agencies promote the efficient growth of Canadian communications systems, helping them adjust to changing conditions, manage the frequency spectrum, permitting orderly use of communications, issue licences for various types of communications systems, and protect	Canada Year Book, Statistics Canada

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Candian interests in international telecommunications matters. Have students collect information about how to apply for a licence to establish a new radio or television station. Invite a guest speaker from a radio or television station to explain the licencing procedures and operating regulations related to the station.	

XII. ENERGY SYSTEMS (C.) Estimated Time: 10 hours

MAJOR OBJECTIVE: To gain knowledge of various types of energy systems and their uses, and to maintain and repair electrical/electronic systems.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. INTRODUCTION TO ENERGY SYSTEMS The student should be able to: 1. define energy system; 2. identify types and uses of energy systems.	Have students discuss and define energy system. Discuss mechanical, fluid, and electrical/electronic energy systems, emphasizing these principles: a) Mechanical energy systems are those that use gears, pulleys, shafts, chains, and other mechanical devices to transmit a moving force. b) Fluid energy systems are those that use fluidic air and liquid pressures as their prime moving forces. c) Electrical/electronic energy systems are those that use electrical power as their prime moving forces. Have students compile lists and illustrations of uses of each type of energy system, and collect information and do	ENERGY SYSTEM: Group of parts working together to perform some function Pulleys and gears in small engines and automobiles Automobile hoist Airplane landing gear Air hammers Automobile electrical system House distribution panel Radio and television Microcomputers

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	experiments related to how these energy systems can be combined to carry out tasks and operations. Arrange tours of the school, automotive repair shops, offices, and manufacturing plants, and have students compile lists of ways in which these places use mechanical, fluid, electrical/electronic energy systems, singly or combined.	
B. ELECTRICAL/ELECTRONIC ENERGY SYSTEMS The student should be able to:		
1. recognize various types of electrical/electronic energy systems;	Acquaint students with these electrical/electronic energy systems: Manitoba Hydro System, home electrical systems, farm electrical systems, automotive electrical systems, industrial electrical systems, audio systems, aerospace systems, computer systems (watches and clocks, ten-key printing electronic calculators, microcomputers). Have students arrange displays of various types of electrical/electronic energy systems. Have students arrange displays of various types of electrical/electronic energy systems.	Illustrations of various types of electrical/electronic systems

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. identify the uses of various types of electrical/electronic energy systems;	Arrange field trips, invite guest speakers, and view films relevant to the uses of electrical/electronic systems. Have students prepare displays and illustrated reports about these systems and their uses: . Manitoba Hydro system for generation and distribution; . home electrical system for services, electrical distribution circuits, protection such as smoke detectors, fire and burglar alarms, major appliances; . farm electrical systems for grain dryers, devices for storing and handling various kinds of farm produce, combines, tractors, communication devices; . automotive electrical systems for generation and distribution; . industrial electrical/electronic systems; . audio systems for automobiles and homes; . aerospace systems for electrical and electronic devices; . computer systems for watches and clocks, ten-key calculators, memory typewriters, microcomputers, word processors, memory and electronic devices in communication systems, and robots/robotics in industry.	
3. compare the various types of electrical/electronic energy systems.	Have students identify basic components and point out the similarities and differences of the various types of electrical/electronic energy systems.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
C. MAINTENANCE AND REPAIR OF ELECTRICAL/ELECTRONIC SYSTEMS The student should be able to:		
1. define troubleshooting;	Have students discuss and define troubleshooting.	TROUBLESHOOTING: The process of determining why a device or circuit is not working as it should
2. develop an understanding of the skills related to troubleshooting;	Emphasize the relationship of these skills to troubleshooting: . identification of defects and procedures for operating test instruments; . identification of tools and materials for repairing defects; . recognition of symptoms of defective devices and circuits; . development of plans to repair defective devices and circuits.	Troubleshooting Technique (colour filmstrip, cassette, study guide), McIntyre Educational Media Understanding Electricity and Electronics, 4th ed., McGraw-Hill, Unit 48
3. explain the procedures for analyzing circuit problems;	Emphasize visual inspection; the use of the senses of smell, hearing, and touch; continuity testing; testing of electron tubes and transistors; testing voltage at supply points such as transformers, battery terminals, and rectifier outputs; and resistance tests.	Colour Organs, Steady Hand Game (kits), Cam-Gard Supply

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
4. use the procedures to locate circuit problems;	Make students aware of these activities pertinent to the various inspection and testing procedures: a) Visual inspection--Thorough visual inspection saves time and expense and results in the detection of loose connectors, broken wires, poor solder joints, burned-out components, burned-out fuses or tripped circuit breakers. b) Smell inspection--Overheated components produce characteristic odors which will aid in locating defective parts. c) Hearing inspection--Overheated components can produce cooking or frying noises, and specific circuit defects can produce distortion or absence of sound. d) Touch inspection--Overheated components, such as transformers, coils, capacitors, and transistors, will feel too warm. e) Continuity tests--A circuit tester or an ohmmeter can determine an open circuit or a short circuit.	Extension Cord Project Experiences With Electrons, South-Western Publishing, Part IV
5. diagnose circuit problems;	Demonstrate the correct procedures for diagnosing devices, appliances, and electrical/electronic circuits. Provide students with opportunities to locate and to explain reasons for minor circuit problems.	
6. repair basic circuits.	Have students apply their diagnosis to the repairing of basic circuits.	

XIII. ELECTRICAL WIRING (C .) Estimated Time: 25 hours

MAJOR OBJECTIVE: To recognize the significance of electrical transmission, circuits, materials, tools, Canadian and local electrical codes, electrical plans, schematic diagrams, and distribution of electricity to household electrical wiring, and to install outlets, lights, switches, and various types of household circuits.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. INTRODUCTION TO ELECTRICAL WIRING The student should be able to:		
1. explain the basic principles of the transmission of electrical energy;	Review by reference to Module XI, Energy Transmission, the principles and process of transmitting electricity from the source of generation to the entrance cable for a house. Have students explain the relationship of input, transmission, control, and output pertinent to transmitting electricity.	Industrial Arts 7-9: Power/Energy (Electricity/Electronics), Module XI - Energy Transmission
2. describe the theory related to the construction of open and closed, series, parallel, and series-parallel circuits;	Review by reference to Module XI, Energy Transmission, the theory related to various types of electrical circuits. Ask students to explain by way of illustrations and demonstrations the relationship of input, transmission, control, and output to the various types of circuits.	Basic Electricity and Electronics: Direct Current (filmstrips, cassettes, study guide), McIntyre Educational Media

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. identify the various tools and fasteners required for electrical wiring;	Review by reference to Module VIII, Tools and Fasteners, the various tools and fasteners necessary for home wiring activities. Emphasize the procedures and safety precautions pertinent to the tools and fasteners.	Industrial Arts 7-9: Power/Energy (Electricity/Electronics), Module VIII - Tools and Fasteners
4. identify the various types and uses of wires, cables, and cords required for electrical wiring;	Review and discuss by reference to Module VII, Components, the kinds of wires and cables used for electrical wiring. Show, discuss, and have students summarize information from a film on wire and cable construction. Ask students to determine the safe current carrying capacity of a wire. Have them conduct a simple experiment using a dry cell and various sizes of wire to indicate that a fire hazard exists when undersized wires carry the load current of a circuit. Demonstrate and allow students to practice correct and safe procedures related to cutting, stripping, and fastening wires and cables.	Industrial Arts 7-9: Power/Energy (Electricty/Electronics), Module VII - Components
5. explain the purpose of the Canadian Electrical Code.	Acquaint students with the contents of the most recent copies of the Canadian Electrical Code and the Provincial Supplement for Manitoba. Emphasize that the Canadian Electrical Code, published every three or	Canadian Electrical Code, Canadian Standards Association

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	four years by the Canadian Standards Association, states the minimum requirements for the safe installation of electrical wiring. Have students refer to the Canadian Electrical Code and the Provincial Supplement for Manitoba throughout study of this module. Invite a local electrical inspector, a building contractor, or an electrician to visit the class to explain the wiring codes used in the community.	
B. HOME ELECTRICAL SYSTEMS The student should be able to: 1. recognize the importance of the electrical system;	Explain, using diagrams and examples, that the purpose of the electrical system is to distribute electrical energy throughout buildings, and that systems consist of conductors, devices, and various types of electrical equipment. Point out that many of the materials and procedures used in home electrical sytems are also used in systems for other buildings.	Experiences With Electrons, South-Western Publishing, Part IX, Units 1, 2, 3, 4, 5 Understanding Electricity and Electronics, 4th ed., McGraw-Hill, Unit 31 House Wiring (filmstrip series), Administration Information Media Educational Aids Maintaining the Lighting and Wiring System (slides, cassettes, manual,

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		script, teacher guide, student workbook), American Association for Vocational Industrial Materials
2. identify the main parts of a typical home electrical system;	Visit a house building project and have students locate these main parts of the home electrical system: service drop, insulators, entrance head, service entrance cable, kilowtt-hour meter, grounding wire, load center, branch circuits, individual circuits, small appliance circuit, and general purpose circuit.	Electrical House Wiring Explained, Residential Electrical Wiring: Planning and Roughing In, Residential Electrical Wiring: Finishing the Installation, Residential Electrical Wiring: Voltage and Special Circuits (colour filmstrips, cassettes, study guide), McIntyre Educational Media
3. explain the importance of electrical plans.	Show students examples of household electrical plans, emphasizing these elements: . well-planned wiring; . electrical plans meeting safety and service standards; . household electrical plans showing the locations of each electrical service point; . standard symbols in electrical plans aiding in development and reading of plans. Encourage the students to work in groups to consider the following questions: a) Why should house wiring begin with planning? b) What are some of the reasons electrical planning must meet safety and service standards?	Household electrical plans

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	c) Why locate electrical service points in certain positions in the house? d) Why use standard symbols in household electric plans? Have students use plans to locate the service entrance and to trace the electrical service through the distribution panel into the branch circuits.	
C. HOUSEHOLD DISTRIBUTION The student should be able to:		
1. explain the purpose of the service entrance to a household;	Have students collect information about and describe the function of the service entrance in a household electrical system. Ask them to study the service entrances to their homes or other buildings.	Experiences With Electrons, South-Western Publishing, Part IX, Unit 2
2. describe the functions of the various parts of the service entrance;	Have students learn the function of the service entrance and its parts by preparing diagrams showing the transformer, the distribution wires, the entrance cables, the service head, the service drop, and the conduit with service entry wires, meter, service entry equipment, main switch, and circuit breaker or fuses.	Electrical Service Entrance (filmstrip, audio tape, lesson plan, activity sheet, summary card), Singer Education Division

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. explain the use of the distribution panel;	Emphasize the relationship of the distribution panel to the service entrance, the meter, wiring plans, and the schematic wiring diagram for a household. Show students a distribution panel and have them prepare a labelled diagram of it to explain its use. Point out the voltage requirements for an electric range, electric dryer, electric water heater, heating, air conditioning, workshop, lights, appliance outlets, and outdoor lights. Ask students to answer these questions: a) Why are separate circuits necessary for ranges, dryers, water heaters, heating, air conditioning, and workshops? b) Why is it important to plan in advance for the adding of electrical circuits? c) How is it possible to allow for expansion of wiring and additional branch circuits? d) What special care is necessary for outdoor wiring?	
4. identify reasons for using circuit breakers and fuses.	Acquaint students with the various types of circuit breakers and fuses. Have them locate circuit breakers and fuses in homes and other buildings and explain their uses in the distribution of electricity in a household. Ask students to prepare displays, charts, and reports to indicate	Experiences With Electrons, South-Western Publishing, Part IX, Unit 5

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	classifications and features of and reasons for various types of circuit breakers and fuses in the distribution of electricity in homes.	
D. INSTALLATION OF CIRCUITS The student should be able to:		
1. sketch an electrical plan;	Show students examples of electrical plans. Have them prepare a sketch of a floor in a house and label the locations of outlets correctly.	
2. prepare a schematic diagram for circuits in various locations in a house;	Diagram circuits in various locations in a house, and then have students follow the same procedure. Ask them to indicate the voltage needed for each circuit and to explain why various voltage ratings are required.	Electrical Wiring--Residential (series of coloured transparencies, overlays, instructor's guide), Administration Information Media Educational Aids
3. install electrical outlets.	Have students use the Canadian Electrical Code, local codes, textbooks, and schematic diagrams to collect information pertinent to installing electrical outlets: their location, the distances between them, the procedures for roughing in the mountings, and the number of outlets allowed in circuits. Discuss the reasons for using various types and sizes of boxes. Draw a diagram of a	Experiences With Electrons, South-Western Publishing, Part IX, Unit 3

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	studded wall section, labelling types and heights of boxes and roughed in dimensions related to the installation; have students follow the same procedure. Ask students to select and arrange the tools and materials needed to install electrical outlets, explaining their selection. Demonstrate how to rough in boxes on a framed wall section, and have students follow the same safe procedure, evaluating and testing their finished proejct.	Electrical Wire and Cable, Electrical Boxes, Installing Electrical Boxes and Cable, Installing Electrical Boxes and Conduits (filmstrips, audio tapes, lesson plan, activity sheet, summary card), Singer Education Division
E. LIGHTING AND SWITCHES The student should be able to:		
1. explain the relationship between switches and the operation of lighting fixtures;	Demonstrate the control features of switches, emphasizing the functions of opening and closing circuits, and transferring current from one path to another.	
2. identify the types of switches;	Show students examples of these switches: toggle switch or single-pole, single-throw switch; three-way switch or single-pole, double-throw switch; and four-way switch. Have students prepare displays of illustrations of switches, labelled displays of actual switches, and reports on the construction and uses of switches.	Experiences With Electrons, South-Western Publishing, Part IX, Unit 4 Electrical Switches (filmstrip, audio tape, lesson plan, activity sheet, summary card), Singer Education Division

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. sketch a schematic of a lighting circuit using a single-pole, single-throw switch;	Diagram a lighting circuit using a single-pole, single-throw switch. Have students prepare a similar diagram.	
4. install a simple wall-mounted light fixture and a single-pole, single-throw switch;	Have students use reference sources to determine the standards for locating light fixtures and switches, the requisite tools and materials, and the procedures for installing fixtures and switches. Demonstrate the necessary procedures and safety precautions for completing, evaluating, and testing the finished project. Have students follow these procedures.	Repairing Fluorescent Lights, Replacing a Wall Switch, Replacing a Light Fixture, Replacing a Receptacle, Replacing a Three-Way Switch, The Wire Stripper (filmstrips, audio tapes, lesson plans, activity sheet, summary card), Singer Education Division
5. explain schematics of lighting circuits using other types of switches.	Give students opportunities to read about and explain lighting circuits using three-way and four-way switches.	Electricity (pictotext and Pictostrip series), Administration Information Media Educational Aids
F. INSTALLATION OF CIRCUITS The student should be able to:		
1. assemble various types of basic circuits used in electrical construction;	Ask students to identify the types of materials and tools required for various basic circuits. Demonstrate the assembly procedures and the safety precautions.	Electrical Wiring (filmstrip series), Administration Information Media Educational Aids Electrical Wiring (colour filmstrips, cassettes, student guide), McKnight Publishing

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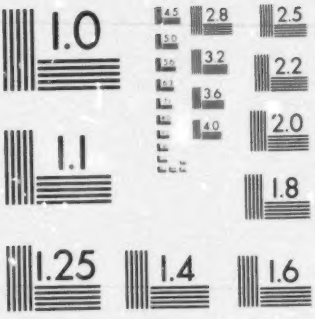


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Provide students with activities such as job sheets and opportunities to work on individual and group projects for assembling the following circuits: . one hundred ampere service; . kitchen counter outlets; . bedroom power and lighting circuits; . split switched living room outlet; . door bell circuits; . fluorescent and incandescent light circuits; . range and dryer outlets; . one hundred and twenty volt single phase split phase motor circuit.	Electrical House Wiring (colour filmstrips, cassettes, guide), Prentice-Hall Media Electrical House Wiring (8 mm colour film loops, instructor's guide), Prentice-Hall Media
2. explain the types of basic circuits used in electrical construction;	Ask students to explain, evaluate, and test their basic circuit projects.	Locating Defective Circuit Parts (filmstrips, audio tape, lesson plan, activity sheet, summary card), Singer Education Division
3. describe the purpose of a ground fault interrupter.	Show students examples and illustrations of ground fault interrupters and have them prepare reports on their various uses.	

power mechanics

CORE MODULES: Student Orientation, Safety, Careers, Measurement, Planning and Design, Consumerism, Tools and Fasteners, Energy Sources, Energy Conversion, Transmission of Power, Routine Care and Maintenance

POWER MECHANICS

I. STUDENT ORIENTATION (C.) Estimated Time: 3 hours

MAJOR OBJECTIVE: To explore and relate the significance of industrial arts to the needs of individuals, industry, and society.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	NOTE: Refer to Common Modules for Module I, Student Orientation.	Industrial Arts 7-9: Power/Energy (Electricty/Electronics, Power Mechanics, Power/Energy), Module I, Student Orientation Joint Explorations Program for Home Economics/Industrial Arts 7, Interim Guide, Manitoba Department of Education
	Emphasize that individuals and businesses are influenced by the vastly changing technology of transportation and power; that the modules in Power Mechanics will present the basic theory and information about systems of measurement, pollution, and careers related to transportation and power; and that, through projects and problems, students will have opportunities to explore basic principles pertinent to solving the challenge of a speed, space, and energy crisis. Make students aware that the Industrial Arts 7-9: Power Energy educational	The Basic Book of Power Mechanics, American Technical Society, Introduction, Unit 1

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	program is pertinent to a body of related subject matter (Electricity/Electronics, Power Mechanics, Power/Energy), and is organized to develop understanding about the technical, consumer, occupational, recreational, organizational, managerial, social, historical, and cultural aspects of industry and technology. Point out that the program includes experiences (such as exploring, experimenting, designing, constructing, and evaluating) and processes to develop creativity and problem-solving abilities and to aid students in making informed and meaningful occupational choices. Develop a reference file of specific industrial arts programs and make the file available to students in the classroom or shop.	

II. SAFETY (C.) Estimated Time: 4 hours

MAJOR OBJECTIVE: To develop safety consciousness and practice in the use of tools, machines, and processes through a wide range of exploratory experiences related to individuals and to production and servicing aspects of relevant hobbies and industries.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	NOTE: Refer to Common Modules for Module II, Safety. Emphasize the following: a) Students studying the basics of power mechanics must learn safety precautions. b) The right way of doing a job is the safe way. c) The use of safety precautions provides protection against injury. d) Safety is a matter of common sense and good judgment. e) Applying safety precautions in all laboratory activities is essential to making them a part of regular work habits.	Industrial Arts 7-9: Power/Energy (Electricty/Electronics, Power Mechanics, Power/Energy), Module II, Safety Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 2 The Basic Book of Power Mechanics, American Technical Society, Unit 2 Small Engine Shop Safety, Small Engine Series Part II and Automotive Shop Safety, Automotive Series Part II (filmstrip and cassette), School Services of Canada

III. CAREERS (C.) Estimated Time: 3 hours

MAJOR OBJECTIVE: To gain information about the general occupational characteristics of a variety of career fields and to match interests, abilities, likes, dislikes, and values to characteristics of various careers.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	NOTE: Refer to Common Modules for Module III, Careers. Integrate career instruction throughout this area of study by familiarizing students with both the many career choices and the foundations on which these are based, and by encouraging them to evaluate themselves in relation to career opportunities and future goals. Point out that a knowledge of career opportunities in power mechanics will aid students in determining future educational and voctional endeavours. Point out that Power Mechanics is not a career within itself, but rather many occupational areas. Develop displays, posters, slides, and filmstrips for the shop or classroom providing information about occupations related to power mechanics.	Industrial Arts 7-9: Power/Energy (Electricty/Electronics, Power Mechanics, Power/Energy), Module III, Careers Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 1 Modern Power Mechanics, Bobbs-Merrill Educational Publishing, pp. 25-27, 46-49, 71, 101-105, 168-170, 258-260 Power: Mechanics of Energy Control, McKnight Publishing, Chapter II The Basic Book of Power Mechanics, American Technical Society, Unit 32 Power Mechanics, McKnight Publishing, Chapter 1 CAREERS C - Concern, Cooperation, Choice, Competence A - Appearance, Attendance, Attitude R - Reading, 'Riting, 'Rithmetic, References

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		E - Experience, Equality, Example E - Effective use of time R - Respect, Recognition S - Spirit
	Encourage each student to develop a file of personalized occupational information, including information on personal interests, aptitudes, and achievements.	The World of Automotive Technology, Part I Automotive Series (filmstrip and cassette), School Services of Canada The World of Small Engine Technology, Part I Small Engine Series (filmstrip and cassette), School Services of Canada

IV. MEASUREMENT (C.) Estimated Time: 10 hours

MAJOR OBJECTIVE: To gain knowledge and skills related to imperial and SI metric systems of measurement and to apply these to measurement activities and problems pertinent to power mechanics.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate the instruction, application, and practice of measurement, along with critical thinking and safety procedures related to it, throughout this area of study.	
A. INTRODUCTION OF MEASUREMENT The student should be able to:		
1. define measurement;	Have students discuss and define measurement. (Students should enter this definition, along with others that arise from this area of study, in their notebooks.) Point out that measurement is a process of comparing an unknown to a known quantity and that different units of measurement exist for different items.	
2. explain the importance of measurement;	Make students aware of the relationship of measurement to power mechanics. Point out that skill in measurement is needed to determine measurements in power mechanics as they pertain to length; area; volume; fuel and oil consumption; time; velocity; acceleration; frequency; tire revolutions; force; torque; pressure, viscosity; energy	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	and work; power; temperature; electrical current, potential, resistance; and distance related to breaker point gaps, piston travel, and bearing diameter. Have students locate specifications for small engines, snowblowers, lawn mowers, snowmobiles, chain saws, motorcycles, and various sizes and makes of automobiles, and then discuss and interpret the different types of measurements applicable to power mechanics and related areas of study.	
3. recognize the need for standards.	Point out that standards for the various measurements pertaining to power mechanics have been developed over the years and agreed upon by organizations such as ISO, ANSI, and CSA, with representation from many industries. Indicate that these standards, the same throughout the world, aid in communicating information about the various measurements related to power mechanics. Inform students that published standards define measurements of length, volume, weight, time, electricity, and other values. Indicate that measurement standards in power mechanics may be expressed by the imperial or by the SI metric stystem.	ISO: International Organization for Standardization ANSI: American National Standards Institute CSA: Canadian Standards Association Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 8 Mechanics of Small Engines, 2nd ed., S metric, McGraw-Hill Ryerson, Introduction, pp. 1-5 Power Mechanics, McKnight Publishing, Chapter 1 SI: System International, a worldwide system of weights and measures

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Acquaint students with these aspects of the SI metric system: the seven base units, the prefixes indicating the size of units, and the symbols for bbase units and prefixes. Have them prepare charts about baseunits, prefixes, and symbols for classroom use. Encourage students to determine the use of base units and prefixes in power mechanics and related areas of study. Discuss the following tabulations: BASE UNITS OF SI METRIC SYSTEM Base Units — Use — Symbol Meter — Measures length — m Kilogram — Measures mass — kg Second — Measures time — s Ampere — Measures electrical current — a Kelvin — Measures temperture — K Candela — Measures luminous intensity — ca Mole — Measures amount of substance — mol	Metrics for Auto Mechanics (colour filmstrips, cassettes, program guide), Prentice-Hall Media

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	PREFIXES FOR UNIT SIZES Decimal Equivalent / Prefix / Symbol 1,000,000 — mega — M 1,000 — kilo — k 100 — hecto — h 10 — deka — da 1 — unit 0.1 — deci — d 0.01 — centi — c 0.001 — milli — m 0.000 001 — micro — u	
B. MEASUREMENT AND POWER MECHANICS The student should be able to: 1. explain force, energy, work, power, distance, volume, capacity, temperature, pressure, and torque;	Point out the importance of being able to describe force, power, energy, and work during the study of power mechanics in the same way as engineers and scientists do. Make students aware that the force may cause an object at rest, or an object in motion, to move faster or slower or to change direction. Have students define and discuss the relationship between energy, work, and power. Provide and ask for practical	FORCE: Push or pull against any object ENERGY: The capacity, the potential, or the ability to do work

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	examples during the discussion.	WORK: Energy used in moving an object against an opposing force POWER: The rate or speed at which work is done
	Discuss these examples of distance measurements related to small engine mechanics: breaker point gap, piston travel, and diameter of a bearing. Explain that each of the distances are measured in millimetres.	QUANTITIES MEASURED IN SMALL ENGINE MECHANICS 1. DISTANCE: The length of the straight line between two objects or points in space 2. VOLUME: The space that something takes up
	Have students discuss the relationship of capacity to fuel tanks, oil pumps, piston displacements. Explain that capacity is measured in cubic centimetres and litres.	3. CAPACITY: The amount that a container can hold
	Point out that cooling systems are measured by the Celsius scale.	4. TEMPERATURE: The amount of heat or cold as measured by a thermometer
	Emphasize that energy is put forth by an engine, that if one engine can do more work than another in a certain length of time, then it is more powerful, and that the power is measured in watts and kilowatts.	5. POWER: The rate or speed at which work is done
	Point out that pressure exerted by a carburetor delivering fuel to the cylinders is measured in pascals (PA).	6. PRESSURE: The application of force to something by something else in direct contact with it

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Emphasize that the twisting force of a crankshaft of an engine and a torque wrench is measured in newton meters (Nm).	7. TORQUE: The measure of a twisting force
	Make the students aware that force is measured in newtons (N).	8. FORCE: The push or pull against any object
	Discuss the measurement of these types of energy: mechanical, fluidic, electrical, solar, wind, water, geothermal, etc.	9. ENERGY: The capacity, potential, or ability to do work
2. define potential energy and kinetic energy;	Show the differences between the two types of energy, by using diagrams, demonstrations, and experiments. Have students define the two types of energy. Have them consider these facts: gasoline in an engine has potential chemical energy; its potential energy is converted into heat energy through ignition; the heat energy is used to push the pistons down and can be seen as kinetic energy in the rotating crankshaft.	POTENTIAL ENERGY: Stored energy KINETIC ENERGY: Energy in motion
3. recognize the need for measurement in power mechanics;	Discuss the need to understand and carry out measurements pertaining to force, energy, work, power, electricity, and electronics in power mechanics.	Power: Mechanics of Energy Control, McKnight Publishing, pp. 23-28
4. perform various types of measurements;	Demonstrate the use of various types of measuring tools and instruments. Discuss the relationship of SI metric measurements to measuring tools and instruments and to the process of measurement. Provide stu-	TYPES OF MEASURING AND TESTING EQUIPMENT Rules/scales Micrometers

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	dents with opportunities to explain and/or practice the procedures for using tools and instruments to measure revolutions per minute, horsepower, wattage, torque, compression ratios, displacement, dwell, timing, distance, diameters, temperature, current, voltage, and resistance. Have students apply requisite safety precautions and maintenance when handling measuring tools and instruments.	Feeler gauges Calipers Dial indicators Gapping tools Dwell meter Compression gauges Vacuum gauges Spring tension gauges Hydrometers Voltmeters Ammeters Ohmmeters Torque wrenches
5. solve problems related to measurement in power mechanics.	Explain the applications of the power and energy rules and formulas, using diagrams, experiments, and practical demonstrations. Give students opportunities to use these rules/formulas, and their variations, to solve problems related to work, energy, power, electricity: . Watts = Volts x Amperes; . Work = Distance x Force; . Power = $\frac{\text{Distance x Force}}{\text{Time}}$; . Torque = Force x Distance; . E = I x R (Ohm's Law); . E = P + I (Power Formula); Discuss and demonstrate these aspects of the torque principle of power:	Small Gas Engine, Goodheart-Willcox, Chapter 8 The Basic Book of Power Mechanics, American Technical Society, Units 8, 9 ENGINE MEASUREMENTS IN METRIC 1. Cylinder bore: mm millimetre 2. Piston travel/stroke: mm millimetre 3. Piston displacement: cm^3 cubic centimetres 4. Engine power: Kw killowatts 5. Engine torque: Nm newton metres 6. Oil pressure: KPa kiiopascals

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	a) There are situtions, as in reciprocating (back-and-forth-movement) engines, where the power output is rotational (turning). b) The twisting force produced by rotational power is called torque. c) Torque is always measured force, multiplied by distance such as pound-feet, pound-inch, ounce-inch, newton-metres, depending upon the system of measurement used. d) Torque wrenches use rotational forces to tighten fasteners within certain limits to prevent the development of stress and strain.	7. Intake manifold pressure: KPa kilopascals 8. Crankcase capacity: l litres 9. Fuel tank capacity: l litres 10. Operating temperature: °C degrees Celsius

V. PLANNING AND DESIGN (C.) Estimated Time: 6 hours

MAJOR OBJECTIVE: To develop skills in and to understand the principles of planning and design, and to apply these skills and principles to power mechanics.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate planning and design where applicable in other modules in this area of study.	
A. PLANNING FOR POWER MECHANICS The student should be able to:		
1. define planning;	Have students discuss and define planning. Point out that the process of planning involves two important resources, people and things, to meet human and business needs.	PLANNING: The process of identifying and preparing details
2. understand the need for planning;	Describe the importance of planning for all modules of power mechanics. Point out that planning is a key element related to managing and completing work, activities, and projects in power mechanics and to applying learning to new and real-life situations.	
3. identify the components of planning.	Emphasize that planning in power mechanics is a process of coopertion between people, using resources, equipment, tools, and time to meet the needs of society, business, and industry.	COMPONENTS OF PLANNING 1. Formulating 2. Researching 3. Designing 4. Engineering

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Explain the components of planning and point out their importance to long- and short-term planning in power mechanics. Emphasize that scheduling and coordinating aid in completing work projects related to power mechanics. Indicate that improper planning can result in wasted time, materials, and effort, leading to higher costs.	FORMULATING: The process of deciding what to make to meet needs RESEARCHING: The process of gathering facts to assist with decision making DESIGNING: The process of developing and creating a plan ENGINEERING: The process of adding details to designs and of scheduling for completion
B. DESIGN The student should be able to:		
1. recognize the fundamentals of design;	Discuss the definition of designing. Indicate that while design processes may differ among the various kinds of activities, work, and projects in power mechanics, certain design principles are constant.	
2. explain the relationship of design to strength, function, materials, cost, and quality;	Use examples to explain the influence of design guidelines on the design process. Have students consider the following questions during the discussion: a) Strength--Will the design make the product strong and durable?	DESIGN GUIDELINES 1. Strength 2. Function 3. Appearance 4. Materials 5. Cost 6. Quality

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	b) Function--Does the design fit the purpose for which it was planned? c) Appearance--Do the parts appear to belong together? d) Materials--Have the materials been used effectively? e) Cost--Does cost relate to strength, function, appearance, materials, and quality of finished work? f) Quality--Is quality an inherent part of the completed work/project? Point out that these interrelated guidelines are common and necessary to all designs. Explain the relationship of changes in design to demand, to energy and fuel problems, and to production, advertising, and sales.	
3. identify the steps in the design process.	Explain the steps related to the design process. Explain the relationship between each of the steps to the development of projects in power mechanics. Urge students to consider projects as design problems and to use plan sheets to determine answers to these questions: a) State the problem--What is the purpose of the project and how will it be used? b) Think through the problem--What are some of the limitations to be considered and by what methods have other persons dealt with these?	STEPS IN DESIGN PROCESS 1. Identify problems 2. Apply resources 3. Formulate ideas 4. Record ideas 5. Refine projects 6. Present projects

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	c) Develop ideas--What kinds of charts, diagrams, and/or sketches are needed to portray ideas and determine materials necessary for their development? d) Prepare flowcharts--What construction steps are necessary? e) Prepare drawings--How should the drawings be developed and prepared? f) Complete the project--How should the drawing(s) be used to complete the project? Encourage students to compile notebook records of their own ideas and of ideas from other sources. Have them prepare bulletin board displays illustrating the applications of the design steps to power mechanics and parts used in power mechanics (small engines, lawn mowers, snow blowers, motorcycles, automobiles, trucks, farm tractors, jet planes). Point out the relationship of power and electricity/electronics to the design steps in power mechanics. Make students aware that the design of power mechanisms influences how efficiently and economically these convert energy to useful work.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
C. PROJECT CONSTRUCTION The student should be able to:		
1. read drawings;	Show students examples of drawings of various types of products, parts, power systems, and electricty/electronics systems used in power mechanics. Explain the symbols used in the drawings. Have students answer questions by reading drawings.	Drawings of products, parts, power systems, electricity/electronics systems in power mechanics
2. prepare drawings;	Explain the purpose of drawings and the importance of being able to read and prepare drawings in power mechanics activities and projects. Have students prepare drawings for power mechanics projects, following a demonstration.	
3. construct models.	Have students use the information from plan sheets, drawings, and production flowcharts to construct models of mechanical systems, fluid systems, electrical systems, and combined systems. Encourage students to assess the construction process and the completed models on the basis of planning and design principles and to compare the input components, materials, labour, energy, and other resources to the quality of workmanship and the time and money expended.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Emphasize planning and quality control, as well as manufacturing and service operations. Have students prepare research reports, oral presentations, and/or displays about the influence of computer technology on planning, designing, and constructing models.	

VI. CONSUMERISM (C.) Estimated Time: 3 hours

MAJOR OBJECTIVES: To explore and relate the economic system and the economy to power mechanics and consumer awareness.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate instruction, practice, critical thinking, and applications related to the study of consumerism throughout each module in this area of study.	
A. ECONOMIC SYSTEMS AND POWER MECHANICS The student should be able to: 1. define economic system;	Explain the term economic system, emphasizing that it refers to the following: . the links between individual workers and managers, productive organizations such as factories or farms, and government agencies, forming a system, a unit, or an organization; . the decision-making process determining what workers, productive organizations, and government agencies will do to answer basic economic questions facing each nation, province, and local community.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	List the basic economic questions. Point out how they relate, in the area of power mechanics, to businesses, services, products, and consumers. Make students aware that political, social, religious, and moral systems influence economic systems and that economic systems change from one country to another and within a single country over a period of time. Point out that by using and consuming resources, the various economic systems produce power mechanics goods and services for consumers to purchase and use. Explain that the following economic activities provide consumers with products for goods and services related to power mechanics: mining, manufacturing, agriculture, and construction. Make students aware of the need for individuals and businesses to choose wisely in selecting goods and services and to use resources effectively during the production of goods and services related to power mechanics.	BASIC ECONOMIC QUESTIONS 1. What to produce? 2. How to produce it? 3. Who will receive the services and finished products? 4. How much to produce over a period of time?
2. explain the basic parts of economic systems;	Identify the basics required by economic systems to produce goods and services: inputs, processes, and outputs. Make students aware of the relationship of these parts to power mechanics, businesses,	BASIC PARTS OF ECONOMIC SYSTEMS 1. Inputs 2. Processes 3. Outputs

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	services, and products. Emphasize the following: a) Outputs are goods and services produced by an economic system. b) Processes are work activities required to produce goods and services. c) Inputs are resources required for the work activities to produce goods and services. Have students give examples of outputs, processes, and inputs for work activities related to the services and products of power mechanics.	
3. identify basic types of inputs.	Review the definition of inputs, listing basic types and emphasizing that they are common to various organizations, such as schools, families, clubs, and businesses. Discuss the relationship among the basic inputs and their application to the production of goods and services for consumption by businesses and individuals.	BASIC TYPES OF INPUTS 1. People 2. Knowledge and skills 3. Industrial resources 4. Utilities 5. Finance
B. POWER MECHANICS AND CONSUMERISM The student should be able to:		
1. identify human needs;	Make students aware of the importance of the following human needs: physical,	Looking at the Consumer, Gage Publishing

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	societal, intellectual, and emotional. Relate Maslow's pyramid of human needs to to the services and products of power mechanics. Have students identify basic physical, societal, intellectual, and emotional needs. Point out the relationship between these needs and work activities, services, and products pertinent to power mechanics.	The Confident Consumer, Goodheart-Willcox HUMAN NEEDS PRIORIZED BY MASLOW 1. Physical 2. Security 3. Love and acceptance 4. Esteem 5. Self-actualization
2. explain how the services and products of power mechanics meet human and business needs;	Emphasize that services and products related to power mechanics are available in different societal and economic systems. Have students compile charts, displays, collages, and/or illustrated reports about the different types of services and products of power mechanics to explain the need of society, businesses, and individuals for each type. Ask students to explain how the services and products, provided through the medium of power mechanics, assist society and individuals to meet these basic needs: shelter, food, water, and clothing.	Charts Bulletin board displays
3. recognize the relationship between power mechanics and the economy.	Discuss the importance of various industrial and business activities to national, provincial, regional, and local levels of economy. Have students investigate the	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	effects of industrial and business activities on employment and businesses related to power mechanics. Make students aware of the ways industries, businesses, and individuals use the services and products of power mechanics to produce other services and goods for consumption by various sectors of the economy.	
C. POWER MECHANICS AND THE MARKETPLACE	Point out why prospective users of the services and products of power mechanics should develop an understanding of the marketplace and its relationship to the economy.	
The student should be able to:		
1. differentiate between needs and wants;	Have students compile lists of the services and products of power mechanics which individuals may desire as opposed to need. Make students aware of businesses that need and want the services and products of power mechanics. Have students prepare lists of the services and products of power mechanics used by businesses.	The World of Business: A Canadian Profile, Wiley Publishers of Canada, Chapter 18, Unit C NEEDS: Things needed by an individual for survival WANTS: Things desired by an individual for pleasure and comfort

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. explain the concepts of quality versus cost and supply and demand;	Discuss with students the following concepts: quality versus cost, cost versus application, influence of demand on supply and cost, the state of the economy, financing, and advertising. Relate these concepts to the users and producers of the services and products of power mechanics. Have students discuss and research the following points: . consideration of alternative products and methods; . importance and process of comparative shopping; . evaluation of safety features; . intensification of energy costs and economic problems; . increased necessity of wise buying and usage practices; . assessment of dictums such as "always buy the best" which may not lead to the most effective use of money; . consideration of different factors for different products; . development of the habit of asking questions. Make students aware of the relationship of these concepts to various aspects of the services and products of power mechanics: . planning and design; . human needs;	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. availability and use of resources; . employment; . availability and choice of the various services and products of power mechanics. Have students prepare research reports, complete with charts and tabultions, on the costs associated with the operation of a power lawn mower, a car, or a tractor. Discuss energy and environmental problems and the need for new non-polluting, energy-producing techniques.	
3. describe the effects of inflation;	Explain the major causes and effects of inflation, emphasizing the effect of inflation on individuals, industries, and businesses in general and on businesses and industries related to power mechanics in particular.	
4. identify the positive and negative aspects of credit buying.	Discuss the direct and indirect costs of credit, and its advantages and disadvantages, to individuals and businesses. Have students compare the costs of items, particularly products and services related to power mechanics, purchased on cash and credit terms by individuals and businesses. Have them compare in reports the costs related to buying a car and a motorcycle, and the fuel for each, on a cash and a credit basis.	Looking at the Consumer, Gage Publishing, Chapter 3

VII. TOOLS AND FASTENERS (C.) Estimated Time: 6 hours

MAJOR OBJECTIVE: To develop knowledge about and skill in the use of hand tools, power tools, and fasteners, and to apply this knowledge and skill to power mechanics.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Refer to Power/Energy for Module VI, Tools and Fasteners. Encourage students to develop an understanding of tools and fasteners through participating experiences like these: . completing a tool identification sheet; . using a tool application sheet; . using various scales for standard and metric measurements; . measuring thicknesses of engine parts with a micrometer; . using a torque wrench; . testing compression of an engine; . using voltmeters and ohmmeters to measure electricity; . tightening and loosening bolts with various types of wrenches; . soldering two pieces of wire together and/or welding two pieces of metal together; . using a solderless connector to fasten two lengths of wire together.	Industrial Arts 7-9: Power /Energy (Power/Energy), Module VII, Tools and Fasteners Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Chapter 8 Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 5 Energy and Transportation: Automechanics, Prentice-Hall, Unit 2 Experiences With Electrons, South-Western Publishing, Part XIII, Unit 2 Experiences With Electrons, South-Western Publishing, Part XIII, Units 3, 4, 5

VIII. ENERGY SOURCES (C.) Estimated Time: 15 hours

MAJOR OBJECTIVE: To understand the significance of energy sources and to develop knowledge and skills related to the application of energy sources to fuel and ignition systems.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. SOURCES OF ENERGY The student should be able to:		
1. identify the various sources of energy;	Discuss how sources of energy have changed and developed in relation to the research and needs of individuals and society. Have students, individually or in groups, prepare illustrated reports on early and present applications of these sources of energy: muscle, simple machine, water, air, steam, electric, internal combustion, continuous combustion, solar, and nuclear power. Encourage students to experiment and/or prepare scrapbooks and displays illustrating how energy sources generate power.	Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Sections 2-5 Power: Mechanics of Energy Control, MKnight Publishing, Chapter 7 Energy and Transportation: Power, Prentice-Hall, Unit 2
2. recognize the relationship of each source of energy to power machanics;	Have students, individuallly or in groups, prepare displays showing past and present applications of energy sources to power mechanics.	
3. compare the various types of liquid and gas fuels.	Point out that liquids and gases under pressure produce a force which can be applied to do work in lawn mowers, snow-	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	blowers, garden cultivators, motorcycles, automobiles, tractors, airplanes, and spacecraft. Ask students to list the various liquid and gas fuels and to state the advantages and disadvantages of each. Have them research the methods of production, characteristics, uses, and air pollution factors associated with each. Discuss the influence of liquid and gas fuels on the processes of designing, manufacturing, and maintaining equipment and vehicles.	LIQUID FUELS 1. Gasoline 2. Diesel 3. Gasohol 4. Alcohol GAS FUELS 1. Propane 2. Hydrogen
B. FUEL SYSTEM The student should be able to: 1. describe the function of a fuel system;	Explain that a fuel system functions in various sizes of engines to supply the correct mixture of air and fuel, providing good engine performance under varying operating conditions. Identify and describe the various air-fuel ratios requisite for varying conditions of operation.	Fuel System (colour filmstrip, cassette), McIntyre Educational Media

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. identify the components of a fuel system;	Acquaint students with the fuel systems of small engines and/or an engine from a vehicle. Have them trace the flow of fuel and locate each component in these fuel systems, determining the locations and types of fuel filters.	COMPONENTS OF THE AUTOMOBILE FUEL SYSTEMS 1. Fuel tank 2. Fuel filter 3. Fuel pump 4. Fuel injectors 5. Carburetors 6. Fuel lines Cutaways of fuel systems
3. explain the purpose of each of the components of a fuel system;	Have students study diagrams, models of components, and/or actual working systems to describe the purpose of each of the components.	Components of fuel systems The Fuel System, Group 1 Automotive Mechanics (colour transparencies, overlays, guide), Administration Media Information Educational Aids Mechanics of Small Engines, 2nd ed., SI metric, McGraw-Hill Ryerson, Chapter 7
	Demonstrate and then have students disassemble and assemble fuel pumps to determine the flow of fuel, how pressure is created, and the parts. Explain the operation of a fuel injection system.	Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 8 Power Mechanics, McKnight Publishing, Chapter 5 Energy and Transportation: Small Engines, Prentice-Hall, Unit 4 Energy and Transportation: Automechanics, Prentice-Hall, Unit 4

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		Various types of fuel pumps
4. perform carburetor adjustments.	Explain the function of a carburetor and have students locate and explain the function of these carburetor parts: float and float bowl, idle valve, needle valve, throttle or butterfly valve, choke, venturi, and jets.	CARBURETOR: A part that mixes and meters air and fuel in correct amounts to burn in the engine The Basic Book of Power Mechanics, American Technical Society, Units 16-21, 25
	Have students use proper procedures for disassembling, checking, and reassembling carburetors to determine the flow of fuel, to identify all the carburetor parts, and to determine how to make basic adjustments. Make students aware of the relationship between carburetor adjustments and engine performance.	Small Gas Engines, Goodheart-Willcox, Chapter 3
	Have students prepare cross-section view charts showing the operation of various carburetor systems.	VENTURI: A restricted/constricted area in the carburetor used to develop the vacuum that draws in fuel
C. IGNITION SYSTEM The student should be able to:		
1. explain the function of an engine ignition system;	Have students discuss and define ignition. Point out that ignition is a method used to start an air-fuel mixture burning in an	

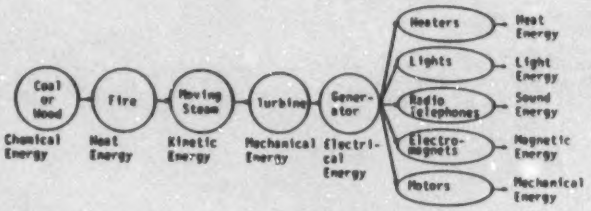
TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	engine cylinder. Emphasize that the spark(s) must arrive at the engine cylinder at exactly the right time and be strong enough to ignite the mixture.	
2. recognize the different types of ignition systems;	Use transparencies, diagrams, textbook illustrations, and/or actual ignition systems to acquaint students with the three basic types of spark ignitions. Have them identify the types of vehicles and engines which use the different types of spark ignition. Use illustrations and demonstrations to explain the principles of operation related to each ignition system.	BASIC TYPES OF SPARK IGNITION 1. Conventional ignition systems . battery and coil . magneto . dynamo coil 2. Electronic ignition systems . contact-breaker magneto . solid-state magneto . capacitor discharge 3. Compression ignition systems
3. identify the components of an ignition system;	Acquaint students with the ignition systems of small engines, and have them locate each component of the ignition systems for small-engines and/or automobile engines.	Cutaway diagrams/models of ignition systems COMPONENTS OF IGNITION SYSTEMS 1. Battery 2. Ignition switch 3. Ignition coil 4. Ignition distributor 5. Spark plugs 6. Wiring 7. Condenser 8. Points The Electrical System, Group III Automotive Mechanics series, Administration Information Media Educational Aids

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
4. explain the operation of the components of an ignition system;	Have students study diagrams, models of the components, and/or actual vehicles in order to describe the operation of each component. Have students draw and label the complete ignition system, showing every component and every wire used to connect them. Obtain the components of a small engine or an automotive ignition system. Have students, individually or in groups, mount the components on a large flat board and wire them as the ignition system in a small engine or an automobile engine is wired.	Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 6 The Basic Book of Power Mechanics, American Technical Society, Units 10-15 Power Mechanics, McKnight Publishing, pp. 71-72 Energy and Transportation: Automechanics, Prentice-Hall, pp. 77-86 Mechanics of Small Engines, 2nd ed., SI metric, McGraw-Hill Ryerson, Chapter 9 Small Gas Engines, Goodheart-Willcox, Chapter 5
5. adjust the ignition system.	Review the components and principles of operation of ignition systems. Have students use the proper procedures for adjusting ignition systems. Ask them to perform and explain the use of these activities: setting points, timing, and magneto armature gaps; and testing coil and condenser.	Ignition System (colour filmstrip, cassettes), McIntyre Educational Media

IX. ENERGY CONVERSION (C.) Estimated Time: 24 hours

MAJOR OBJECTIVE: To understand the application and influence of energy conversion processes in relation to basic engine design, two- and four-stroke cycle engines, other internal combustion engines, and cooling and lubrication systems.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. ENERGY AND CONVERSION The student should be able to:		
1. recognize the importance of energy;	Make students aware that energy is all important. Ask them to discuss these concepts: a) Energy is used to get a job done. b) Energy causes things to happen. c) Energy is the capacity or ability to do work. d) Power, light, sound, motion, heat, and life itself depend upon energy. e) Energy exists in many forms. f) All forms of energy are related. g) Sun is the source of all energy. Have students prepare lists, diagrams, displays, and experiments dealing with these energy concepts.	Energy and Transportation: Power, Prentice-Hall, Unit 2
2. describe energy conversion.	Point out that according to the Law of Conservation of Energy, energy cannot be created or destroyed, but can be changed into different forms, such as light, sound, heat, motion, and electricity.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	 Prepare a transparency and have students prepare charts and displays related to the above diagram, showing that energy exists in many forms, that no new energy is produced by conversion, and that energy comes from wood or coal which, in turn, owe their life to the sun. Emphasize that energy harnessed for work must be changed from natural forms into other forms. Encourage students to develop an understanding of the energy conversion process and its importance by challenging them with these teaching-learning strategies:	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. presentation of illustrated class reports on the conversion of windpower to mechanical energy, or windpower to electrical energy; . participation in teacher- or student-directed study groups on the conversion of water to mechanical energy to electrical energy; . development of projects or experiments to illustrate the operating principles of converting mechanical to electrical energy and vice versa; . demonstration of the operating principles pertinent to the conversion of chemical to electrical energy; . preparation of diagrams, projects, or experiments related to the conversion of alternating to direct current; . class discussion or reports about geothermal, nuclear, and solar energy and the conversion of each to electrical energy; . demonstration of automobile engine operation to indicate that electrical energy is stored in batteries as chemical energy and discussion of the conversion process; . discussion of the conversion of energy in an electric car.	
B. BASIC ENGINE DESIGN	Review the concept that fuels and legislation influence the design of engines. Have	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
The student should be able to:	students trace the design evolution of the internal combustion engine by preparing illustrated timelines, reports, scrapbooks, or biographical sketches of people involved with the development, or by building models with accompanying manuals.	
1. explain the operating principle of the internal combustion engine;	Emphasize these points: a) The internal combustion engine is designated as a heat engine. b) The power for the engine is produced by burning fuel which releases power during the burning process. c) The term internal indicates that fuel is burned inside the engine. d) The presence of oxygen is necessary to support combustion/burning. e) The fuel must be a mixture of fuel and air. f) The fuel mixture burns rapidly by almost exploding to produce energy. g) The design of the engine must allow for the harnessing of the energy. h) The internal combustion engine converts reciprocating motion into useful rotary motion.	The Basic Book of Power Mechanics, American Technical Society, Unit 3 Small Gas Engines, Goodheart-Willcox, Chapter 1 Energy and Transportation: Small Engines, Prentice-Hall, Unit 1

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. identify the basic components of internal combustion engines;	Acquaint students with the basic components of an internal combustion engine by using diagrams, charts, service manuals, cutaways, and models of engines.	BASIC ENGINE COMPONENTS 1. Cylinder 2. Piston 3. Crankshaft 4. Connecting rod 5. Valves 6. Crankcase
3. explain the functions of the basic components of internal combustion engines.	Have students discuss and research or view models of the functions of each of the basic components and how these components work together.	
C. TWO- AND FOUR-STROKE CYCLE ENGINES The student should be able to:		
1. define cycle;	Have students discuss and define cycle.	CYCLE: A series of repetitive events
2. describe the operation of two- and four-stroke cycle engines;	Relate the definition of cycle to the operation of two- and four-stroke cycle engines. Demonstrate the operation of two- and four-stroke cycle engines. Ask students to prepare posters, charts, or displays to show each cycle of a two-stroke and a four-stroke cycle engine. Take the head off an old four-stroke cycle engine, turn the crankshaft by hand and ask	Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 6 Mechanics of Small Engines, 2nd ed., SI metric, McGraw-Hill Ryerson, Chapters 3 and 4 Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Units 7, 8

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	students to observe the motion of pistons and the position of valves and to follow the intake, compression, power, and exhaust cycles.	Four-Stroke Cycle Engine: Basic Parts and Operations (colour filmstrip, cassettes), McIntyre Educational Media
3. recognize the application of two- and four-stroke cycle engines;	Encourage students to identify the different kinds of machines which use two- and four-stroke cycle engines.	Energy and Transportation: Small Engines, Prentice-Hall, Units 2, 3
4. compare two- and four-stroke cycle engines.	Have students discuss, prepare reports or charts, and/or use disassembly and assembly procedures to compare construction and operation of two- and four-stroke cycle engines.	Energy and Transportation: Small Engines, Prentice-Hall, Units 2, 3, 4, 5
	Demonstrate disassembly and assembly procedures. Provide students with lists of the procedures that they can follow. Have them complete a record after each step of the disassembly in a chart similar to the one given below.	Power Mechanics, McKnight Publishing, Chapter 5 Small Gas Engines, Goodheart-Willcox, Chapter 2 The Basic Book of Power Mechanics, American Technical Society, Units 3-9
	RECORD OF DISASSEMBLY PROCEDURES	The Four-Stroke Cycle Internal Combustion Engine, Engine Components, Valve Mechanisms and the Two-Stroke-Cycle, The Fuel System, The Lubricating and Cooling System, The Basic Engine Series (colour filmstrips, cassettes, guide), Prentice-Hall Media

Part	Disassembly (nuts, bolts, etc.)	Operation Performed	Tool Used

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		Engine Disassembly (colour filmstrip, cassette), McIntyre Educational Meida
D. OTHER INTERNAL COMBUSTION ENGINES The student should be able to:		
1. identify other types of internal combustion engines;	Have students discuss and use illustrations and models to identify diesel, jet, rocket, rotating, turbine, and K-cycle engines. Have students research to determine information about the people, nations, and industries responsible for the invention and development of other types of internal combustion engines.	Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 7 Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Units 10-15 Energy and Transportation: Small Engines, Prentice-Hall, Unit 8
2. explain the operating principles of other types of internal combustion engines;	Encourage students to compare the operating principles of other types of internal combustion engines by using diagrams, posters, and operating manuals, by examining engine parts, by visiting industries, and by experimenting. Have students carry out some of these activities: . demonstration of jet-fuel principle with an aerosol can; . preparation of a simple model out of paper or cardboard to illustrate the compression ratio of 17 to 1;	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. collection and examination of diesel parts for labelled display; . demonstration of the principle of action and reaction using a balloon, a length of fine wire, masking tape, and a plastic drinking straw; . launching CO cars; . launching of model rockets; . demonstration of the flow of hot gases through a gas turbine on a poster or model indicating a cumbustor, compressor, gasifier turbine, power turbine, and regenerative drums; . construction of a model to explain the cycle of the rotary combustion engine; . examination of a K-cycle engine.	
3. recognize the applications of other types of internal combustion engines.	Have students prepare reports or displays to identify the different machines, vehicles, and industries using types of diesel, jet, rocket, turbine, and K-cycle engines. Discuss the relationship of these engines to fuels.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
E. COOLING SYSTEM The student should be able to:		
1. explain the need for a cooling system in internal combustion engines;	Review the definition and operating principles of an internal combustion engine. Point out that a cooling system is one of several subsystems needed to operate an engine efficiently. Ask students to describe the need for cooling systems and to identify the machines and vehicles using air-cooled and liquid-cooled systems.	Modern Power Mechanics, Bobbs Merrill Educational Publishing, Section 6 Mechanics of Small Engines, 2nd ed., SI metric, McGraw-Hill Ryerson, Chapter 5
2. differentiate between air-cooled and liquid-cooled systems;	Discuss the construction, components, and operating principles of both cooling systems. Have students trace the path of cooling liquid and cooling air through an engine and describe the operation. Have them compare the cost of each system. Ask students to discuss this question: What important job does oil perform in the engine?	Cutaway models Diagrams of cross sections The Basic Book of Power Mechanics, American Technical Society, Units 26-27
3. inspect cooling systems.	Demonstrate and then have students perform procedures for inspecting the two types of cooling systems.	Small Gas Engines, Goodheart-Willcox, Chapter 7

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
F. LUBRICATION SYSTEM The student should be able to:		
1. identify the functions of lubricating oil;	Define friction as it applies to internal combustion engines. Demonstrate how friction causes heat and wear and how lubricating oil reduces friction. Discuss the theory of lubrication and have students prepare reports or demonstrations explaining the functions of lubricating oil.	FRICTION: The resistance to motion between parts in contact with each other FUNCTIONS OF LUBRICATING OIL 1. To seal power 2. To dissipate heat 3. To keep engine clean 4. To cushion bearing loads 5. To protect against rusting 6. To minimize wear
2. describe the basic types of engine lubrication systems;	Emphasize that lubrication is one of several subsystems which function together for efficient engine operation. Explain, using diagrams, models, or actual engines, these basic types of lubrication systems: splash, pressure-feed, fuel-oil. Have students identify the components and explain the operating principles of each lubrication system. Ask them to list engines and machines that use the different types of lubrication systems.	Modern Power Mechanics, Bobbs Merrill Publishing, Section 6 Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 8 Mechanics of Small Engines, 2nd ed., SI metric, McGraw-Hill Ryerson, Chapter 6 The Basic Book of Power Mechanics, American Technical Society, Units 28-31

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. select oil for different types of lubrication systems.	Emphasize the importance of knowing about different viscosities, qualities, refining companies, additives, and the meaning of related advertising terms. Ask students to obtain empty oil containers and literature about the viscosity and rating of the oil that each contained; have them mark this information on the containers, and refer to when choosing oil for different types of lubricating systems. Demonstrate and have students use the tools, equipment, supplies, and procedures for maintaining the various types of lubrication systems. Point out to students that procedural steps differ for the many makes of engines.	Small Gas Engines, Goodheart-Willcox, Chapter 6 Energy and Transportation: Automechanics, Prentice-Hall, Unit 5 Energy and Transportation: Small Engines, Prentice-Hall, Unit 6

X. TRANSMISSION OF POWER (C.) Estimated Time: 12 hours

MAJOR OBJECTIVE: To explore the purposes and methods of power transmission and to gain knowledge and skills related to mechanical, fluid, and electrical power transmission.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Indicate that in the language of scientists and engineers, power refers to how fast work is done, or how fast energy is transferred. Emphasize that power sources would be useless without ways of getting the power to do useful work and that various devices and systems are used in the process of power transmission. Point out that the power of an engine can be transmitted dirrectly and indirectly. Make students aware of these three indirect methods of power transmission: mechanical, fluid, electrical.	POWER: The rate of doing work and the rate of energy conversion
A. MECHANICAL POWER TRANSMISSION The student should be able to:		
1. define mechanical power transmission;	Show students examples of mechanical power transmission, and have them define it. Point out that mechanical transmission involves gears, pulleys, chain drives, levers, shafts, feed screws, clutches, belts, and flexible couplings as transmission media.	MECHANICAL POWER TRANSMISSION: Transmission and control of motion through gears, pulleys, shafts, and other devices

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		MECHANICAL TRANSMISSION DEVICES 1. Automobile brake system 2. Automobile transmission 3. Mechanical jack 4. Levers 5. Pulleys and belts 6. Gears and chains 7. Axles 8. Drive shafts
2. explain the relationship of transmission to input, control, and output in a mechanical power system;	Make students aware of the relationship of transmission to input, control, and output by discussing and demonstrating the following: a) Input is the form in which motion is produced and placed in a mechanical system, such as the production of motion in an automobile when gases expand in the combustion chamber of the engine. b) Output is the motion taken from the system, such as the revolving of rear wheels in an automobile. c) Control is the process of using various control devices to change motion between input and output, such as the transmission of an automobile being used to change the speed and direction of the rotation of tires.	Power Mechanics, McKnight Publishing, Chapter 2

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. describe the principles of operation related to mechanical transmission devices.	Ask students to compare and explain the relationship of transmission to input, control, and output in small and jet engines and turbines. Emphasize that mechanical transmission principles can: . change the size of applied force; . change the direction of applied force; . change the speed that results from applied force. Apply these principles to various gears, belts and pulleys, couplings, and clutches used to transmit power in power mechanics. Have students participate in these activities to learn about the principles of mechanical power transmission: . experimentation with ggears to change mechanical advantage and direction of rotation; . use of a bicycle or an internal combustion engine to change reciprocal to rotary motion; . development of projects or experiments illustrating with pulleys of different diameters the principle of speed changes; . discussion of mechanical advantage, direction of rotation, reciprocal motion, rotary motion, and overdrive;	Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 10

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. demonstration and explanation of the influence of friction in mechanical power transmission; . preparation of diagrams, posters, and displays to illustrate various mechanical transmission systems.	
B. FLUID POWER TRANSMISSION The student should be able to:		
1. describe fluid power transmission;	Point out that fluid power transmission involves using a liquid or a gas as the transmission media in a dynamic system; it refers to generation, control, and application of the power of pummped and/or compressed fluids to push, pull, rotate, regulate, and drive many mechanisms. Have students prepare reports and experiments to explain the work of Blaise Pascal on pressure applied to a confined fluid.	FLUID POWER TRANSMISSION: Transmission and control of motion and power through gas and liquid Power Mechanics, McKnight Publish'ng, Chapter 3 Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 10 Energy and Transportation: Power, Prentice-Hall, Unit 3
2. identify fluid transmission devices;	Indicate that fluid power transmission uses liquids in hydraulic devices and gases in pneumatic devices. Ask students to make scrapbooks, posters, and displays and working models of fluid transmission devices.	FLUID TRANSMISSION DEVICES 1. Hydraulic jacks 2. Hydraulic cylinders 3. Hydraulic brake systems

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. explain the principles of operation related to fluid transmission devices.	Discuss the advantages of fluid transmission devices encountered in everyday life and in power mechanics. Discuss these basic laws pertinent to liquids as a source of power: liquids cannot be compressed, but can be used to transmit power and to multiply force. Describe these basic laws related to air and gases as sources of power: air and gases can be compressed, and used to transmit power and multiply force. Ask students to compare hydraulic and pneumatic power transmission. Have students participate in these activities to learn about the operating principles of fluid power transmission: . demonstration and explanation of the operation of a hydraulic jack and calculation of the mechanical advantages of the force it provides; . examination of the parts of hydraulic and air brake systems; . inspection of the parts and operation of an automobile hoist at a service station; . study of literture describing energy absorbing automobile bumpers;	4. Automatic transmission 5. Power steering system 6. Hydraulic clutches Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Units 26, 27

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. disassembly and assembly of some types of hydraulic cylinders; . discussion of the need for cleanliness in the maintenance and care of hydraulic systems; . disassembly and assembly of some type of pneumatic device; . construction of a model airplane with an engine using pressurized carbon dioxide (CO_2) for power; . preparation of working models, reports, and displays focused on devices and machines powered by hydraulic and pneumatic energy.	
G. ELECTRICAL POWER TRANSMISSION The student should be able to:		
1. define electrical power transmission;	Show students examples of electrical power transmission in power mechanics. Point out that electrical power transmission involves the use of wires and other conductors in various subsystems in small engines and automobiles.	ELECTRICAL POWER TRANSMISSION: Transmission and control of motion of power through the use of electricity
2. describe the various ways of supplying electricity in small engines;	Show students examples of magnetos, solid state devices, and batteries used to provide electricity for ignition systems in small engines.	Small Gas Engines, Goodheart-Willcox, Chapter 5

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. explain the principles of operation related to electrical power transmission in small engines;	Discuss the operating principles of magnetos, solid state devices, and batteries and their components involved in the transmission of electrical power in small engines. Encourage students to build, demonstrate, explain, and test magnetos, solid state ignition, and battery ignition. Have students find and investigate differences among various types of magnetos and batteries used in small engines to transmit electrical power.	Mechanics of Small Engines, McGraw-Hill Ryerson, Chapter 9 Energy and Transportation: Small Engines, Prentice-Hall, Unit 5 The Basic Book of Power Mechanics, American Technical Society, Units 10-15
4. describe the various uses of electricity in an automobile;	Discuss and have students develop displays and obtain illustrations of the various uses of electricity in automobiles.	Energy and Transportation: Automechanics, Prentice-Hall, Unit 6
5. explain the electrical wiring in an automobile;	Use charts, posters, and transparencies to describe the electrical wiring system in an automobile and to identify its components. Have students trace this system.	
6. identify the parts of the starting, charging, and ignition system in an automobile.	Show students the starting unit, ignition unit, distributor, and charging system in an automobile by using charts, posters, and transparencies. Have them identify the components of each.	

XI. ROUTINE CARE AND MAINTENANCE (C.) Estimated Time: 20 hours

MAJOR OBJECTIVE: To recognize the significance of and to acquire knowledge and skills applicable to routine care and maintenance, basic tune-ups, and diagnostic procedures for small and automotive engines.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. SMALL ENGINE CARE AND MAINTENANCE		
	Emphasize that regular checking and care and maintenance aid in ensuring longer life for engine parts and lower repair costs. Point out that the best source of information on small engine care and maintenance is the owner's manual or operator's instruction booklet.	Owner's Manual Operator's Instruction Booklet
The student should be able to:		
1. reconize the need for routine care and maintenance of small engines;	Discuss these reasons for care and maintenance: . to keep the engine operating at peak efficiency; . to prevent undue wear of engine parts.	
2. locate and record information about small engines;	Have students read owner's manuals or operator's instruction booklets to record the following information:	Small Engine Fundamentals, Prentice-Hall

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	engine manufacturing and model number, type of engine: two- or four-cycle, rated horsepower and revolutions per minute, bore, stroke, displacement, summer-type oil, winter-type oil, how often oil should be checked and changed, spark plug type, spark plug gap, how often spark plugs should be cleaned and breaker points checked, breaker point gap, type of air cleaner, how often air cleaner should be cleaned, type of air cleaner solvent, type of cooling system, how often cooling system should be checked and/or cleaned. Have students examine a small engine in light of this information.	
3. perform basic routine care and maintenance related to oil supply, cooling system, spark plugs, and air cleaners.	Make students aware of the need to perform routine care and maintenance on small engines, related to oil supply, cooling system, spark plugs, and air cleaners. Emphasize the importance of checking the oil supply in the crankcase of a four-cycle engine prior to use and of referring to the owner's manual or operator's instruction booklet for information about oil changes. Point out tht oil changes are not necessary on two-cycle engines, because the fuel used by engines consists of a mixture of oil and	Small Engine Service and Overhaul (colour filmstrips, cassettes, program guide), Prentice-Hall Media Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 9 Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 9 Small Gasoline Engines: Maintenance, Troubleshooting, and Repair, Reston Publishing Power Mechanics of Energy Control, McKnight Publishing, Chapter 9

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	gasoline. Demonstrate changing oil in four-cycle engines, and have students follow the same procedure.	Small Engines Explained (series of colour filmstrips, cassettes, guide), McIntyre Educational Media Inspection and Valve Reconditioning, Engine Disassembly, Cylinder Recondition, Engine Assembly, Routine Care and Maintenance (colour filmstrips, cassettes), McIntyre Educational Media
	Acquaint students with both air and water cooling systems. Emphasize the need to check cooling systems and carry out these procedures: a) Air cooling system--Frequent cleaning of the radiating fins, flywheel vanes, and shrouds to prevent a build up of deposits that reduce the engine's cooling capacity. b) Water cooling system--Checking the water level in the radiator and replenishing to the correct level before operating the engine. Review the purpose and structure of spark plugs. Show students examples of spark plugs with these problems: carbon fouling, burned electrodes, chipped insulator, and splash fouling. Discuss and demonstrate these procedures for cleaning and regapping spark plugs:	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES

. removing spark plug and examining its condition;
. checking spark gap before cleaning and resetting;
. wire brushing the shell and threads,
. cleaning the insulator with rag soaked in solvent;
. cleaning electrodes and sparking surfces,
. regapping spark plug to the correct setting;
. reinstalling the plug.

Review the function of air cleaners and have students report on the need for their periodic cleaning. Ask students to identify oil-type and dry-type air cleaners and their components.

Demonstrate cleaning each type of air cleaner. Have students follow these procedures and record each step on a chart similar to the one below.

Part	Disassembly (nuts,bolts,etc.)	Operation Performed	Tool Used

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
B. SMALL ENGINE STORAGE AND RETURN TO SERVICE The student should be able to:		
1. explain the need for preparing a small engine for storage;	Emphasize the importance of preparing a small engine for storage.	Mechanics of Small Engines, 2nd ed., SI metric, McGraw-Hill Ryerson, Chapter 10 Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 9
2. perform the procedures for storing a small engine;	Acquaint students with these pre-storage procedures, indicating that necessary repairs should be included: . the fuel system drained; . the upper cylinder injected with oil; . the crankcase on a four-cycle engine drained; . the outside of the engine cleaned; . the engine wrapped in dustproof material and stored in dry place. Have students follow these procedures and then explain each step in report.	
3. prepare a small engine for return to service.	Have students follow and explain these steps for returning a small engine to service: . engine taken from storage and dustproof wrapping removed; . oil level checked on a four-stroke cycle engine;	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. spark plug cleaned and regapped; . air cleaner element and bowl cleaned; . fuel tank, fuel line, and filter screen cleaned; . fuel tank filled with fresh fuel; . engine started and carburetor adjusted for smooth running at all speeds.	
C. SMALL ENGINE TUNE-UP The student should be able to:		
1. describe the purpose of a small engine tune-up;	Emphasize that an engine tune-up, more complex than basic care and maintenance, is necessary for proper engine operation. Point out that rather than involving major engine repair work, it indicates whether major repairs are necessary, and that experienced engine owners or mechanics can do tune-ups.	Energy and Transportation: Small Engines, Prentice-Hall, Unit 7 Power: Mechanics of Energy Control, McKnight Publishing, Chapter 9
2. perform small engine tune-up procedures.	Demonstrate, and then have students use, these basic procedures for small engine tune-ups: . air cleaner inspected and cleaned; . gas tank, fuel lines, and any fuel filters or screens cleaned; . compression checked; . spark plug checked, cleaned, regapped, and/or replaced;	Power Mechanics, McKnight Publishing, Chapter 5 Small Gas Engines, Goodheart-Willcox, Chapter 9 Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 9

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. operation of the governor checked; . magneto checked . crankcase of four-stroke engines filled with clean oil of the correct type; . fuel tank of a two-stroke cycle engine filled with the correct mixture of gasoline and oil; . engine started; . carburetor adjusted for peak performance.	Small Engine Know-How (sets of colour filmstrips, cassettes), McKnight Publishing
D. DIAGNOSIS OF A SMALL ENGINE The student should be able to:		
1. explain the function of diagnosis;	Emphasize that diagnosis, often referred to as troubleshooting, is a systematic step-by-step process, involving mental activity and decision-making rather than physical activity. Make students aware that to follow diagnosis/troubleshooting procedures requires knowledge of engine operation as well as common sense.	Energy and Transportation: Small Engines, Prentice-Hall, Unit 7 Power Mechanics, McKnight Publishing, Chapter 5
2. perform various diagnostic procedures.	Encourage students to study manufacturers' manuals to obtain thorough knowledge of engine operation. Prepare troubleshooting charts and have students use these while checking and correcting faults in small engines.	Mechanics of Small Engines, 2nd ed., SI metric, McGraw-Hill Ryerson, Chapter 10 Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 9

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Arrange a series of troubleshooting contests for students to participate in. Ask students to bring in malfunctioning or nonfunctioning engines on which to practice troubleshooting procedures.	Power: Mechanics of Energy Control, McKnight Publishing, Chapter 9
E. AUTOMOTIVE ENGINE MAINTENANCE The student should be able to: 1. explain the need for automobile engine maintenance;	Ask students to locate in manuals information about automotive engine maintenance and to prepare reports or displays about its importance.	
2. describe the various types of maintenance required on automobile engines.	Point out that an automobile engine requires four systems in order to run. Review the function and components of cooling, lubricating, fuel, and electrical systems. Have students carry out these maintenance procedures by participating in various teaching-learning strtegies: . discussing these causes of cooling system problems: engine overheating, slow warm-up, leaks;	What Your Car Is Trying to Tell You (colour filmstrip series, cassettes, guide), McIntyre Educational Media Common Sense Car Care, How the Automobile Works, Basic Automotive Service (colour filmstrip series, cassettes, guides), Prentice-Hall Media

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. using cooling system hydrometers and refractometers to check and test anti-freeze; . identifying and performing cooling system maintenance procedures; . discussing these causes of lubrication problems: too much oil used by engines, and malfunction of indicator light or oil-pressure gauge; . identifying and performing oil change procedures; . discussing problems that arise while performing maintenance service procedures on these components of fuel systems: air cleaner, fuel filter, fuel pump, and carburetor; . discussing malfunctions in electrical systems and checking and servicing a battery by carrying out these procedures: inspecting and cleaning terminals and cables, testing battery charge with a hydrometer, recharging a battery, filling a battery, and checking the charging system with a voltmeter. Encourage students to assess the process and completion of routine care and maintenance on the bases of planning principles and by comparing input components, materials, labour, energy, and other resources to the quality of workmanship and the time and money expended.	

power/energy

CORE MODULES: Student Orientation, Safety, Careers, Measurement, Planning and Design, Consumerism, Tools and Fasteners, Energy Sources, Energy Conversion, Transmission of Power and Energy, Power Systems

I. STUDENT ORIENTATION (C.) Estimated Time: 3 hours

MAJOR OBJECTIVE: To explore and relate the significance of industrial arts to the need of individuals, industry, and society.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	NOTE: Refer to Common Modules for Module I, Student Orientation.	Industrial Arts 7-9: Power/Energy (Electricity/Electronics, Power Mechanics, Power/Energy), Module I, Student Orientation
	Emphasize that Power/Energy covers many aspects of knowledge and skills from the sources of power to the uses of these different kinds of energy: mechanical, heat, light, chemical, electrical, nuclear, and possible future forms. Sources of power and control of energy have played a vital role in the progress of technology. Conservation and utilization of energy and resources, location of new forms of energy, and the influence of energy are present and future concerns.	Joint Explorations Program for Home Economics/Industrial 7, Interim Guide, Manitoba Department of Education
	Make students aware that Industrial Arts 7-9: Power/Energy consists of educational programs pertinent to a body of related subject matter (Electricity/Electronics, Power Mechanics, Power/Energy), organized to develop understanding about the technical, consumer, occupational, recrea-	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	tional, organizational, managerial, social, historical, and cultural aspects of industry and technology; activities provide students with opportunities for exploring, experimenting, designing, constructing, and evaluating, and processes provide students with opportunities for creating, problem solving, and making informed and meaningful occupational choices.	

II. SAFETY (C.)

Estimated Time: 4 hours

MAJOR OBJECTIVE: To develop safety consciousness and practice in the use of tools, machines, and processes through a wide range of exploratory experiences related to individuals and to production and servicing aspects of relevant hobbies and industries.

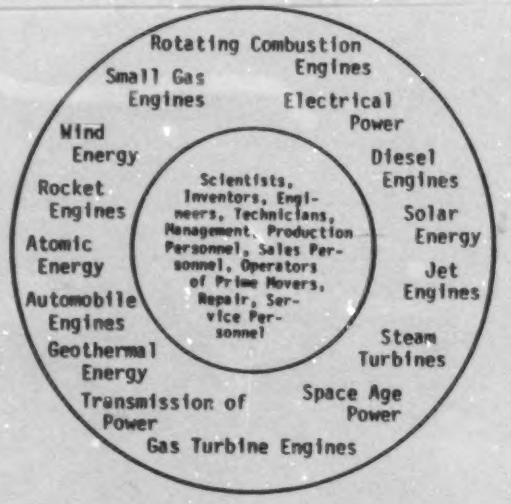
TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	NOTE: Refer to Common Modules for Module II, Safety. Emphasize the following: a) Students studying the basics of power/energy must learn safety precautions. b) The right way of doing a job is the safe way. c) The use of safety precautions is protection against injury. d) Safety is a matter of common sense and good judgment. e) Applying safety precautions in all laboratory activities is essential to making them a part of regular work habits. f) Power and energy may be SHOCKING!	Industrial Arts 7-9: Power /Energy (Electricity/Electronics, Power Mechanics, Power/Energy), Module II, Safety Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 2 Electrical Safety from A to Z, Electricity-Handle with Care, Don't Be Shocked, Electrical Safety Around the Farm, Play It Safe, Electrically (colour films), Manitoba Hydro

III. CAREERS (C.) Estimated Time: 3 hours

MAJOR OBJECTIVE: To gain information about the general occupational characteristics of a variety of career fields and to match interests, abilities, likes, dislikes, and values to characteristics of various careers.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	NOTE: Refer to Common Modules for Module III, Careers. Integrate career instruction throughout this area of study by familiarizing students with both the many career choices and the foundations on which these are based, and by encouraging them to evaluate themselves in relation to career opportunities and future goals. Point out that a knowledge of career opportunities in power/energy will aid students in determining future educational and vocational endeavours. Develop various types of display materials for shop or classroom that will provide information about occupations related to power/energy.	Industrial Arts 7-9: Power/Energy (Electricity/Electronics, Power Mechanics, Power/Energy), Module III, Careers Power: Mechanics of Energy Control, McKnight Publishing, Chapter II Experiences With Electrons, South-Western Publishng, Unit I, Topics 1 and 2 Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit I CAREERS C - Concern, Cooperation, Choice, Competence A - Appearance, Attendance, Attitude R - Reading, 'Riting, 'Rithmetic, References E - Experience, Equality, Example E - Effective use of time R - Respect, Recognition S - Spirit

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Encourage each student to prepare a file of personalized occupational information including information on personal interests, aptitudes, and achievements. Emphasize how important it is to be well informed about all aspects of a career from educational requirements to conditions of the work duties and setting to the chances of obtaining employment in a given area. Make students aware that even though interests, attitudes, and work values are important factors in making career decisions, change, risk taking, and giving service for the betterment of persons and life are equally important. Have students research power technology careers. Point out that in every community, power employs many people in these ways: . directly, as service station managers or as employees of the power utility company: . indirectly, as truck, train, bus, or aircraft operators in local or national transportation networks. Have students discuss this diagram and prepare reports on the special talents, interests, and skills related to power technology.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		

IV. MEASUREMENT (C.) Estimated Time: 15 hours

MAJOR OBJECTIVE: To gain knowledge and skills related to imperial and SI metric systems of measurement and to apply these to measurement activities and problems pertinent to work, energy, and power.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate the instruction, application, and practice of measurement, along with the critical thinking and safety procedures related to it, throughout this area of study. For specifics, refer to Electricity/Electronics, Module IV, Measurement, and/or Power Mechanics, Module IV, Measurement.	
A. INTRODUCTION OF MEASUREMENT The student should be able to: 1. define measurement;	Ask students to discuss these concepts: a) Measurement is a process of comparing an unknown quantity to a known quantity. b) Different units of measurement are used for different items. Have them define measurement. (Students should enter this definition, along with others that arise from this area of study, in their notebooks.)	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. explain the importance of measurement;	Make students aware of the relationship of measurement to power/energy. Point out that skill in measurement is needed to determine measurements in power/energy as they pertain to the scientific terms of work, energy, and power and to electricity/electronics and power mechanics.	
3. recognize the need for standards in measurement.	Point out that standards for scientific measurements of work, energy and power have been developed through the centuries and agreed upon by organizations such as ISO, ANSI, and CSA, with representation from many industries. Ask students to consider that measurements standards are: . applicable on a world-wide basis; . communication aids in discussing measurements related to work, energy, and power; . available in published format; . expressed by the imperial and the SI metric system with increasing emphasis on the latter system.	ISO: International Organization for Standardization ANSI: American National Standards Institute CSA: Canadian Standards Association Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 8 "Standard Measurement" (16 mm colour film), Library, Manitoba Department of Education Metrics for Auto Mechanics (colour filmstrips, cassettes, program guide), Prentice-Hall Media SI: System International, a worldwide system of weights and measures
	Explain these aspects of the SI metric system: the seven base units, the prefixes indicating the size of the units, and the	Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 6

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	symbols representing the base units and the prefixes. Encourage students to research the history of measurement for the preparation of illustrated reports on the measuring techniques used by early people and on the historical and scientific developments of measurement.	Power: Mechanics of Energy Control, McKnight Publishing, Chapter 1 BASE UNITS OF SI METRIC SYSTEMS Base Unit — Measurement Use — Symbol meter — length — m kilogram — mass — Kg second — time — s ampere — electric current — a kelvin — temperature — K candela — luminous intensity — ca mole — amount of substance — mol
B. MEASUREMENT AND POWER/ ENERGY The student should be able to: 1. describe work, energy, and power;	Discuss the definitions of work, energy, and power pertinent to this area of study, by emphasizing with practical examples these concepts: work involves moving things by applying force, energy relates to the capacity to perform work, and power refers to how fast work is done or how fast energy is transferred.	WORK: The application of force to cause motion ENERGY: The ability to do work POWER: The rate of doing work or the rate of energy conversion

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Acquaint students with the need to measure distance, volume, capacity, temperature, pressure, and torque as they pertain to power and energy.	
2. define potential energy and kinetic energy;	Explain the difference between potential and kinetic energy, and have students define them after considering the following concepts and examples: a) Scientifically described, potential energy is considered as an energy a body has due to its position (water at the top of a waterfall), its condition (a tightly wound watch spring), its chemical state (electricity to be used to operate a machine, or gasoline, coal, or food to be burned up). b) Scientifically explained, kinetic energy should be considered as released potential energy, such as the energy of water falling over a dam, the energy of the moving hands of a watch, the energy of the rotating electric fan or the electric hand drill, the energy of sound from a radio or light from a light bulb, or the energy of a moving automobile or an athlete sprinting, skating, jumping, skiing, or boxing.	POTENTIAL ENERGY: Stored energy KINETIC ENERGY: Released potential energy
3. perform various types of measurements;	Discuss units of measurement. Demonstrate the use of various types of measuring tools and instruments. Discuss the relationship	UNITS OF MEASUREMENT 1. Foot pounds

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	of SI metric measurements to measuring tools and instruments and to the process of measurement. Provide students with opportunities to explain or practice the procedures for using tools and instruments to measure revolutions per minute, horsepower, wattage, torque, compression ratios, displacement, dwell timing, distance, diameters, temperature, current, voltage, and resistance. Have students apply requisite safety precautions and maintenance when handling measuring tools and instruments.	2. Newton 3. Joule 4. Watt 5. Volt 6. Ampere TYPES OF MEASURING AND TESTING EQUIPMENT Rules/scales Micrometers Feeler gauges Calipers Dial indicators Gapping tools Dwell meters Compression gauges Vacuum gauges Spring tension gauges Hydrometers Voltmeters Ammeters Ohmmeters Torque wrenches
4. solve problems related to measurement of work, energy, and power.	Illustrate the practical use of and have students use these rules/formulas and their variations to solve problems related to work, energy, and power:	Introduction to Power Systems, Benziger-Bruce and Glencoe, Lessons 8-11

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. Work = Force x Distance; . Potential Energy = Force x Distance; . Power = $\frac{\text{Force x Distance}}{\text{Time}}$ or $\frac{\text{Work}}{\text{Time}}$; . E = I x R (Ohm's Law); . E = P ÷ I (Power Formula).	

V. PLANNING AND DESIGN (C.) Estimated Time: 6 hours

MAJOR OBJECTIVE: To develop skills in and to understand the principles of planning and design, and to apply these skills and principles to various facets of power/energy.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate planning and design where applicable in other modules in this area of study.	
A. PLANNING FOR POWER/ ENERGY The student should be able to:		
1. define planning;	Have students discuss and define planning. Make students aware that the process of looking ahead involves two important resources, people and things, to meet human and business needs.	PLANNING: The process of identifying and preparing details
2. understand the importance of planning in power/energy;	Explain the relationship between planning and power/energy. Point out that planning is a key element related to managing and completing work and projects related to power/energy.	
3. identify the components of planning.	Emphasize that planning in power/energy is a process of cooperation between many people, using resources, equipment, and tools to meet the needs of society, business, and industry.	COMPONENTS OF PLANNING 1. Formulating 2. Researching 3. Designing 4. Engineering

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	List and define the components of planning. Emphasize the relationship of long- and short-term planning. Point out that scheduling and coordinating aid in the completion of work and projects related to power/energy. Indicate that improper planning can result in wasted motion, materials, and effort, leading to higher costs.	FORMULATING: The process of deciding what to make to meet needs RESEARCHING: The process of gathering facts to assist with decision making DESIGNING: The process of developing and creating a plan ENGINEERING: The process of adding details to design and of scheduling for completion
B. DESIGN The student should be able to:		
1. recognize the fundamentals of design;	Review the definition of designing. Point out that while design functions may differ among the various kinds of work and projects related to power/energy, certain design principles apply to all products related to power/energy.	
2. explain the relationship of design to strength, function, materials, cost, and quality;	Make students aware of the influence of design guidelines on the design process. Have students consider the following questions during the discussion: a) Strength--Will the design make the product strong and durable? b) Function--Does the design fit the purpose for which it was planned?	DESIGN GUIDELINES 1. Strength 2. Function 3. Appearance 4. Components and materials 5. Cost 6. Quality

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	c) Appearance--Do the parts appear to belong together? d) Components and materials--Have the components and materials been used effectively? e) Cost--Does cost relate to strength, function, appearance, materials, and quality of finished work? f) Quality--Is quality an inherent part of the finished work/project? Indicate that these interrelated guidelines are common and necessary to all designs.	
3. identify the steps in the design process.	Explain the steps pertinent to the design process. Make students aware of the relationship between each of the steps to the development of projects in power/energy. Encourage students to think of projects as design problems and to use project plan sheets to determine answers to these questions: a) State the problem--What is the purpose of the project and how will it be used? b) Think through the problem--What are some of the limitations to be considered, and by what methods have others dealt with these? c) Develop ideas--What kinds of charts and sketches are needed to portray ideas and determine components and materials required for their development?	STEPS IN DESIGN PROCESS 1. Identify problems 2. Apply resources 3. Formulate ideas 4. Record ideas 5. Refine projects 6. Present projects Project plan sheets

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	d) Prepare flowcharts--What construction steps are necessary? e) Prepare schematic drawings--How should drawings be developed and prepared? f) Construct the project--How should the schematic drawing(s) be used to complete the project?	
	Encourage students to compile notebook records of their ideas and of ideas from other sources related to the relationship between products and design. Make them aware that it takes time and practice to acquire skill and knowledge to solve design problems in power/energy.	Newspapers, periodicals, and reference books
C. PROJECT/PRODUCT CONSTRUCTION The student should be able to:		
1. collect information from drawings and illustrtions;	Show students examples of drawings and illustrations of various products, parts, and power systems used in power/energy. Have them identify symbols and answer questions related to drawings.	
2. read blueprints;	Ask students questions which require them to read simple blueprints related to aspects of power/energy.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. read and prepare schematic drawings;	Explain the purpose of schematic drawings and the importance of being able to read and prepare schematic drawings in electrical and electronics work. Emphasize that schematics are drawn with standard symbols to indicate the requisite components and/or parts and to illustrate how all the components within circuits, devices, and systems are connected. Have students locate, read, and interpret schematic drawings. Have students prepare schematic drawings for power/energy systems and projects including simple machines, water power, air power, steam power, electrical power, internal combustion power, continuous combustion power, fluid power, solar power, and nuclear power.	Schematic drawings Experiences With Electrons, South-Western Publishing, Part IV, Unit 1; Part XIII, Unit 1 Electronics: Schematic Symbols (filmstrip, slide set, video tape), Administration Information Media Educational Aids
4. construct models and circuits.	Have students use the information on project plan sheets and schematic drawings to construct models, circuits, projects such as mousetrap racers, CO racer, and model rockets. Ask students to assess all the construction processes and the completed model in relation to planning and design principles and to compare the input components, materials, labour, energy, and other resources to the quality of workmanship and the time and money expended.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Emphasize planning and quality control, as well as manufacturing and service operations. Also emphasize that computer technology will be playing a big role in planning, designing, and constructing components, parts, and projects.	

VI. CONSUMERISM (C.)

Estimated Time: 3 hours

MAJOR OBJECTIVE: To explore and relate the economic system and the economy to power/energy and consumer awareness.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Integrate instruction, practice, critical thinking, and applications related to the study of consumerism throughout each module in this area of study.	
A. ECONOMIC SYSTEMS AND POWER/ENERGY The student should be able to:		
1. define economic system;	Explain the term economic system, emphasizing that it refers to the following: . the links between individual workers and managers, productive organizations such as factories or farms, and government agencies, forming a system, a unit, or an organization; . the decision-making process determining what workers, productive organizations, and government agencies will do to answer basic economic questions facing each nation, province, and community.	
	List the basic economic questions. Point out how they relate, in the area of power/energy, to businesses, services, products, and consumers.	BASIC ECONOMIC QUESTIONS 1. What to produce? 2. How to produce it?

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TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Make students aware that political, social, religious, and moral systems influence economic systems and that economic systems change from one country to another and within a single country over a period of time. Point out that by using and consuming resources, the various economic systems produce power/energy goods and services for consumers to purchase and use. Explain that the following economic activities provide products for power/energy goods and services: mining, manufacturing, agriculture, and construction. Point out the need for individuals and businesses to choose wisely in selecting goods and services and to use resources effectively during the production of goods and services related to power/energy.	3. Who will receive the services and finished products? 4. How much to produce over a period of time?
2. explain the basic parts of economic systems;	Identify the basics required by economic systems to produce goods and services: inputs, processes, and outputs. Make students aware of the relationship of these basic parts to power/energy businesses, services, and products. Emphasize the following: a) Outputs are goods and services produced by an economic system. b) Processes are work activities required to produce goods and services.	<u>BASIC PARTS OF ECONOMIC SYSTEMS</u> 1. Inputs 2. Processes 3. Outputs

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	c) Inputs are resources required for work activities to produce goods and services. Have students give examples of outputs, processes, and inputs for work activities related to the services and products of power/energy.	
3. identify basic types of inputs.	Review the definition of inputs, listing basic types and emphasizing that they are common to various organizations, such as schools, families, clubs, and businesses. Discuss the relationship among the basic inputs and their application to the production of goods and services for consumption by businesses and individuals.	BASIC TYPES OF INPUTS 1. People 2. Knowledge and skills 3. Industrial resources 4. Utilities 5. Finance
B. POWER/ENERGY AND CONSUMERISM The student should be able to:		
1. identify human needs;	Make students aware of the importance of the following human needs: physical, societal, intellectual, and emotional. Relate Maslow's pyramid of human needs to the services and products of power/energy.	Looking at the Consumer, Gage Publishing The Confident Consumer, Goodheart-Willcox

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Have students identify basic physical, societal, intellectual, and emotional needs. Point out the relationship between these needs and work activities, services, and products pertinent to power/energy.	HUMAN NEEDS PRIORIZED BY MASLOW 1. Physical 2. Security 3. Love and acceptance 4. Esteem 5. Self-actualization
2. explain how the services and products of power/energy meet human needs;	Emphasize that power/energy and related services and products are available in different societal and economic systems. Have students compile charts, displays, and/or illustrated reports about the different types of power/energy services and products to explain the need of society, businesses, and individuals for each type. Ask students to explain how the services and products, provided through the medium of power/energy, assist society and individuals to meet these basic needs: shelter, food, water, and clothing.	"A Way of Life" (16 mm colour film), Library, Manitoba Hydro Charts Bulletin board displays
3. recognize the relationship between power/energy and the economy.	Discuss the importance of various industrial and business activities to national, provincial, regional, and local levels of economy. Have students investigate the effects of industrial and business activities on employment and businesses related to power/energy. Make students aware of the ways industries, businesses, and individuals use the services and products of	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	power/energy to produce other services and goods for consumption by various sectors of the economy.	
C. POWER/ENERGY AND THE MARKETPLACE		
	Point out why prospective users of the services and products of power/energy should develop an understanding of the marketplace and its relationship to the economy.	
The student should be able to:		
1. differentiate between needs and wants;	Have students compile lists of the services and products of power/energy which individuals may desire as opposed to need. Make students aware of businesses that need and want the services and products of power/energy.	The World of Business: A Canadian Profile, Wiley Publishers of Canada, Chapter 18, Unit C NEEDS: Things needed by an individual for survival WANTS: Things desired by an individual for pleasure and comfort
2. explain the concepts of quality versus cost and supply and demand;	Discuss the following concepts: quality versus cost, influence of demand on supply and cost, economic conditions, financing, and advertising. Relate these concepts to the users and producers of power/energy services and products. Have students discuss and research the following points:	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. consideration of alternative products and methods; . importance and process of comparative shopping; . evaluation of safety features; . intensification of energy costs and economic problems; . increase necessity of wise buying and usage practices; . assessment of dictums such as "always buy the best" which may not lead to effective use of money; . consideration of different factors for different products; . development of the habit of asking questions. Make students aware of the relationship of these concepts to various aspects of power/energy services and products: . planning and design; . human needs; . availability and use of resources; . employment; . availability and choice of the various services and products of power/energy. Have students discuss and prepare reports, displays, and charts emphasizing energy and environmental problems and the need for new, non-polluting, energy-producing techniques.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. describe the effects of inflation;	Explain the major causes and effects of inflation, emphasizing the effect of inflation on individuals, industries, and businesses in general and on businesses and industries related to power/energy in particular.	
4. identify the positive and negative aspects of credit buying.	Discuss the direct and indirect costs of credit, and its advantages and disadvantages, to individuals and businesses. Have students compare the costs of items, particularly products and services related to power/energy, purchased on cash and credit terms by individuals and businesses.	Looking at the Consumer, Gage Publishing, Chapter 3
D. ROLE OF POWER/ENERGY IN CONSUMERISM The student shcuild be able to:		
1. recognize the relationship of sources of energy to the services and products of power/ energy;	Discuss the relationship of energy sources to the services and products of power/ energy and to the industrial, business, and individual consumers of these services and products. Ask students to identify various sources of energy pertinent to the generation of power and electricity. Have students, individually or in groups, research and prepare posters, scrapbooks, and illustrated reports on the generation of power and energy from various sources.	Energy and Transportation: Power, Prentice-Hall, Unit 2

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. explain the consequences pertinent to the consumption of energy sources;	Ask students to identify the users of power and energy in homes, farms, businesses, industries, communications, transportation, science, and medicine.	Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Units 17-20, 25, 28 Electricity and Basic Electronics, Goodheart-Willcox, Chapter 2
3. justify energy conservation and cost consideration.	Have students discuss and then demonstrate, through research, experiments, and projects, the importance of conservation and cost consideration in the consumption of power and energy by industries, businesses, and individuals.	

VII. TOOLS AND FASTENERS (C.) Estimated Time: 10 hours

MAJOR OBJECTIVE: To develop knowledge about and skill in the use of hand tools, power tools, and fasteners, and to apply this knowledge and skill to power/energy.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Emphasize techniques, safety procedures, and the importance of choosing the right tool and/or fastener.	
A. HAND TOOLS The student should be able to:		
1. identify common hand tools;	Have students identify common hand tools or illustrations of them. Ask students to determine on which simple machines several of these tools are based. Review the hand measuring tools presented in Module IV, Measurement.	COMMON HAND TOOLS 1. Measuring tools: . rules and scales (tape, steel, metric, imperial) . dividers . calipers (inside, outside, vernier) . micrometers (metric, imperial) . gauges (feeler, wire, spark plug, telescopic, cylinder) . scratch awls and scribers . squares (try, combination)
2. use hand tools;	Explain that work on engines or mechanical and electrical devices can require tools for these purposes: . screwdrivers and wrenches for repairing and replacing worn parts and for removing bolts or nuts, . hammers and various cutting tools for removing old parts and repairing new parts; . vises and arbor presses for holding objects/parts being worked on.	2. Cutting tools: . chisels (cold, cape, roundnose) . drill bits . files (single cut, double cut, curred cut, rasp)

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		. punches (automatic, centre, chassis, pin) . saws (backsaw, hacksaw, handsaw, keyhole) . tap and die . tin snips . tube cutters 3. Wrenches: . adjustable . box end . combintion . flare nut . hex nut . open end . socket . torque 4. Pliers: . channel locking . diagonal . linesman . long nose . needle nose . vise grips 5. Screwdrivers: . Phillips . Robertson . standard

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		6. Hammers and Mallets: . ball peen . claw . computbane . soft face 7. Nut Drivers 8. Soldering Tools: . heat sink . desoldering solder sucker . soldering gun . soldering iron holder and cleaner . soldering iron/pencil 9. Strippers/Crimpers 10. Vises: . drill press . machinists . panavise
	Demonstrate turning, hammering, cutting, and holding using hand tools, and allow students to practice these procedures. Emphasize the importance of matching hand tools to the task performed. Have students use safety procedures and care in the maintenance of tools. Point out that industries manufacturing mechanical devices, engines, snowblowers, motorcycles, lawn mowers, automobiles, and airplanes are constantly designing new components which may necessitate the use of new tools.	Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Chapter 8 Electronics: A Practical Approach, SI metric, John Wiley and Sons Mechanics of Small Engines, 2nd ed., SI metric, McGraw-Hill Ryerson, Chapter 2 Exploring Power Technology Basic Fundamentals, Goodheart-Hillcox, Unit 5

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. perform the hand tool processes with increasing accuracy.	Discuss, in relation to hand tools, correct use, necessary care and maintenance, and accuracy in the production and performance of top-quality work. Test students frequently on their ability to identify and use hand tools.	The Basic Book of Power Mechanics, American Technical Society, Unit 8 Energy and Transportation: Automechanics, Prentice-Hall, Unit I Wrenches: Identification and Use; Using Screwdrivers, Pliers, and Hammers (colour filmstrips, cassettes, guide), Prentice-Hall Media Introduction to Hand Tools (16 mm film), Library, Manitoba Department of Education
B. POWER TOOLS The student should be able to:		
1. identify common power tools;	Have students identify common power tools or illustrations of them. Have them visit auto parts, hardware, and/or department stores to price the basic power tools used for power/energy projects.	COMMON POWER TOOLS 1. Arbor press 2. Band saw 3. Drill press 4. Grinder 5. Portable drill 6. Scroll saw
2. use power tools;	Demonstrate step-by-step procedures for using each power tool and have students record the steps. Have them read operating	Operating manuals

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	manuals before using power tools. Point out the importance of matching power tools to the tasks performed. Have students use safety, care, and maintenance procedures. Have them diagnose causes of and repair malfunctions in power tools.	
3. perform the power tool processes with increasing accuracy.	Discuss, in relation to power tools, correct use, necessary care and maintenance, and accuracy in production and performance of top-quality work. Test students frequently on their ability to identify and use power tools.	
C. FASTENERS		
The student should be able to:		
1. define fastening;	Have students discuss and define fastening.	FASTENING: The process of binding, connecting, securing, holding, attaching, and/or affixing/sealing one item to another
2. identify methods of fastening;	Have students discuss and define the methods of fastening used in electricity/electronics and power mechanics. Point out these differences among the fastening methods:	FASTENING METHODS 1. Mechanical 2. Adhesive/sealing 3. Fusion

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	a) Mechanical fasteners and related tools affix mechanical fasteners and attach items. b) Adhesive/sealing fasteners and related tools affix/join parts together. c) Fusion mixes or combines molten metals to bind or join metals. Ask students to examine various power mechanics devices, locating and analyzing the many fasteners used in electricity/ electronics and power mechanics devices.	
3. use mechanical fasteners and related tools;	Demonstrate the correct procedures for using mechanical fasteners and related tools. Acquaint students with the standard thread systems used on bolts, machine screws, and studs. Have students collect used fasteners (such as nuts, bolts, and screws) from a junked car, wrecking yard, or auto body repair shop; have them clean and mount the fasteners on a display board, labelling each by name, thread type (where applicable), and size. Allow students to practice selecting and using mechanical fasteners and related tools for various materials. Have them evaluate the procedures and quality of the completed fastening.	MECHANICAL FASTENERS 1. Screws 2. Rivets 3. Bolts and nuts 4. Clips, connectors 5. Studs 6. Washers 7. Snap rings 8. Cotter pins 9. Binding posts and plugs Energy and Transportation: Auto-mechanics, Prentice-Hall, Unit 2 Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 8 Working with Nuts and Bolts (colour filmstrips, cassettes, guide), Prentice-Hall Media

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
4. use adhesive fasteners and related tools;	Demonstrate the correct procedures for using adhesive/sealing fasteners and related tools. Ask students to locate and explain the function of the gaskets used to join engine parts. Allow students to practice selecting and using adhesive/sealing fasteners and related tools for various materials. Have them assess the procedures used and the quality of the work completed.	ADHESIVE/SEALING FASTENERS 1. Glues 2. Gaskets
5. use fusion fastening methods and related tools.	Demonstrate and have students select and use procedures and tools for various materials to be fastened by fusion methods. Encourage students to evaluate the procedures used and the quality of the finished fastening.	FUSION FASTENING 1. Soldering 2. Brazing 3. Welding

VII. ENERGY SOURCES (C.) Estimated Time: 15 hours

MAJOR OBJECTIVE: To recognize the significance of energy sources in the development of civilizations, and to gain information about major and alternate energy sources and their uses and the need for energy conservation.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Refer to Electricity/Electronics, Module IX, Energy Sources, and to Power Mechanics, Module VIII, Energy Sources. Make students aware that throughout history, people have used research done by individuals, industry, and society to develop sources of energy to do their work and to meet the needs of individuals, industry, and society. Emphasize the following aspects of energy sources: . early forms of power--human muscle, animal muscle, horsepower, simple machines; . water power--overshot and undershot waterwheels, water turbine, waves and tides; . air power--air foil principle, compressed air; . steam power--reciprocating steam engine, steam turbines;	Industrial Arts 7-9: Power/Energy (Electricity/Electronics), Module IX, Energy Sources and (Power Mechanics), Module VIII, Energy Sources "Energy," The World Book Encyclopedia, Volume 6, 1981 Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Sections 1-5, 6 Power: Mechanics of Energy Control, McKnight Publishing, Chapters 7, 10 Energy and Transportation: Power, Prentice Hall, Unit 2 "Energy Supply, The New Book of Knowledge, Volume 5, Grolier Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Unit 8 Energy and Transportation: Automechanics, Prentice-Hall, Unit 4

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. electrical power--Electricity/Electronics, Module IX; . internal combustion power--Power Mechanics, Module IX; . continuous combustion power--jet engines, gas turbines, rockets; . alternate sources--atomic energy, nuclear reactors, solar energy, geothermal energy.	Mechanics of Small Engines, 2nd ed., SI metric, McGraw-Hill Ryerson, Chapter 7 Manitoba Resources: Electricity, Energy Realities, The Nuclear Age, Power from the Atom, Progress in Power, Nuclear Waste Management colour films), Manitoba Hydro Energy and Matter, Wind, Energy Dilemma, Energy for the Future, Energy from the Sun, Energy a Matter of Choices, Energy: The Fuels and Man, Energy: The Problems and the Future, Energy Management for the Future (16 mm colour films), Library, Manitoba Department of Education Critical Issues in Science and Society: The Great Energy Debate Parts I and II, Energy-Crisis and Resolution, The Solar Quest, Energy Management for the Future (kits), Library, Manitoba Department of Education

IX. ENERGY CONVERSION (C.)

Estimated Time: 24 hours

MAJOR OBJECTIVE: To gain an understanding of the principles of energy conversion, to recognize the uses and relationship of the forms of energy, and to apply information about methods of producing electricity from other forms of energy to power/energy projects and products.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	Refer to Electricity/Electronics, Module X, Energy Conversion, and to Power Mechanics, Module IX, Energy Conversion.	Industrial Arts 7-9: Power/Energy (Electricity/Electronics), Module X, Energy Conversion and (Power Mechanics), Module IX, Energy Conversion Energy and Transportation: Power, Prentice-Hall, Unit 2 Power: Mechanics of Energy Control, McKnight Publishing, Chapter 1 Electricity and Basic Electronics, Goodheart-Willcox, Chapter 2 Experiences With Electrons, South-Western Publishing, Part II, Unit 2 Exploring Electricity Electronics with the Electrical Team, Projects G and H, pp. 164-168 Energy and Transportation: Small Engines, Prentice-Hall, Units 1, 2, 3, 4, 5, 6, 8

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Sections 6, 7 Exploring Power Technology Basic Fundamentals, Goodheart-Willcox, Units 8, 10-15

X. TRANSMISSION OF POWER AND ENERGY (C.) Estimated Time: 15 hours

MAJOR OBJECTIVE: To explore the purposes and methods of power/energy transmission, to recognize the relationship of input, control, transmission, output, and devices to the various transmission processes, to develop pertinent skills, and to apply the electrical transmission process to communication.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. INTRODUCTION TO TRANSMISSION OF POWER AND ENERGY		
1. define energy transmission;	Have students discuss and define energy transmission.	ENERGY TRANSMISSION: The movement of energy from the point at which it is generated to the point at which it is used
2. recognize the role of power and energy transmission;	Emphasize these aspects of the role of transmission in a power system: a) Transmission is one part of a power system. b) Transmission is related to a power/energy source, load or output, and controls. c) Power must travel from its source to the place where it will be used along a transmission path. d) Transmission means vary from simple screwdrivers to cross-country transmission tower systems. e) Transmission plays a necessary role in making power usable.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
3. identify the methods of power/energy transmission.	Acquaint students with the various methods of power/energy transmission.	METHODS OF POWER/ENERGY TRANSMISSION 1. Mechanical 2. Fluid 3. Electrical
B. MECHANICAL TRANSMISSION The student should be able to: 1. define mechanical power transmission;	Show students examples of mechanical power transmission, and have them define it. Point out that mechanical transmission involves gears, pulleys, chain drives, levers, shafts, feed screws, clutches, belts, flexible couplings, etc., as transmission media.	MECHANICAL POWER TRANSMISSION: Transmission and control of motion through gears, pulleys, shafts, and other devices MECHANICAL TRANSMISSION DEVICES 1. Towing devices 2. Metal rods 3. Universal joints 4. Mechanical jacks 5. Levers 6. Pulleys and belts 7. Gears and chains 8. Axles 9. Drive shafts 10. Augers 11. Shovels and rakes

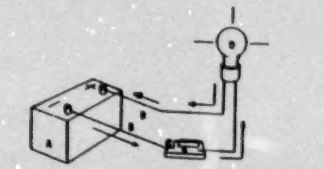
TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. explain the relationship of transmission to input, control, and output in a mechanical power system;	Make students aware of the relationship of transmission to input, control, and output by discussing and demonstrating the following: a) Input is the form in which motion is produced and placed in a mechanical system, such as the production of motion in an automobile when gases expand in the combustion chamber of the engine. b) Output is the motion taken from the system, such as the revolving of rear wheels in an automobile. c) Control is the process of using various control devices to change motion between input and output, such as the transmission of an automobile being used to change the speed and direction of the rotation of tires. Ask students to investigate and compare the relationship of transmission to input, control, and output in towing devices, straight metal rods, and universal joints, in pedals, chains, and sprocket wheels in bicycles, and in small and jet engines and turbines.	Power Mechanics, McKnight Publishing, Chapter 2 Power: Mechanics of Energy Control, McKnight Publishing, Chapter 2 Introduction to Power Systems, Benziger Bruce and Glencoe, Lesson 4
3. describe the principles of operation in mechanical transmission devices.	Emphasize that mechanical transmission principles can: . change the size of applied force;	Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 10

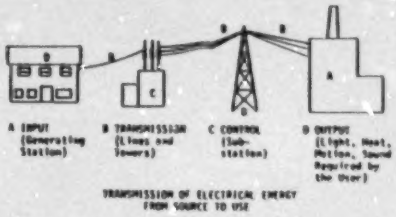
TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. change the direction of applied force; . change the speed that results from applied force. Apply these principles to various towing devices, rods, gears, belts and pulleys, couplings, and clutches used to transmit power. Have students participate in these activities to learn about the principles of mechanical transmission: . using towing devices to move objects and machines; . using screwdrivers to transmit turning force from the handle to the point of use; . experimenting with gears to change mechanical advantage and direction of rotation; . using a bicycle and/or internal combustion engine to demonstrate the changing of reciprocal to rotary motion; . developing projects or experiments to illustrate the principle of speed changes using pulleys of different diameters; . discussing mechanical advantage, direction of rotation, reciprocal motion, rotary motion, overdrive; . demonstrating and explaining the influence of friction in mechanical power transmission;	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. preparing diagrams, posters, and displays to illustrate various mechanical transmission systems.	
C. FLUID POWER TRANSMISSION The student should be able to:		
1. describe fluid power transmission;	Point out that fluid power transmission involves using a liquid or gas as the transmission media in a dynamic system. It refers to generation, control, and application of the power of pumped and/or compressed fluids to push, pull, rotate, regulate, and drive many mechanisms. Have students prepare reports and experiments to explain the work of Blaise Pascal on pressure applied to a confined fluid.	FLUID POWER TRANSMISSION: Transmission and control of motion and power through gas and liquid Power Mechanics, McKnight Publishing, Chapter 3 Modern Power Mechanics, Bobbs-Merrill Educational Publishing, Section 10 Energy and Transportation: Power, Prentice-Hall, Unit 3
2. identify fluid transmission devices;	Indicate that fluid power transmission uses liquids in hydraulic devices and gases in pneumatic devices. Ask students to make scrapbooks, posters, displays, and working models of fluid transmission devices. Discuss the advantages of fluid transmission devices encountered in everyday life and in power/energy pertinent to heavy industry.	FLUID TRANSMISSION DEVICES 1. Hydraulic jacks 2. Hydraulic cylinders 3. Hydraulic brake systems 4. Automatic transmissions 5. Power steering systems 6. Hydraulic clutches

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	farm equipment, road building equipment, and portable power tools.	
3. explain the principles of operation related to fluid transmission devices.	Discuss these basic laws pertinent to liquids as a source of power: liquids cannot be compressed, but can be used to transmit power and to multiply force. Describe these basic laws related to air and gases as sources of power: air and gases can be compressed and used to transmit power and multiply force. Ask students to compare hydraulic and pneumatic power transmission. Have students participate in these activities to learn about the operating principles of fluid transmission: . showing that fluids (gases and liquids) change their shapes when force is applied by filling several balloons with air and water, pressing the balloons, and noting that the air and water change shape; . demonstrating and explaining the operation of a hydraulic jack, and calculating the mechanical advantage of force provided by the jack; . obtaining and examining parts of hydraulic and air brake systems; . visiting a service station to inspect the parts and operation of an automobile hoist;	Exploring Power Technology Basic Fundamentals, Goodheart-Willcox Units 26, 27 Introduction to Power Systems, Benziger Bruce and Glencoe, Lesson 5

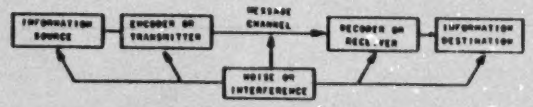
TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	. studying literature describing energy absorbing automobile bumpers; . disassembling and assembling some type of hydraulic cylinder; . discussing the need for cleanliness in the maintenance and care of hydraulic systems; . disassembling and assembling some type of pneumatic device; . constructing and demonstrating a model airplane or car with an engine using pressurized carbon dioxide (CO_2) for power; . preparing illustrated reports and displays about devices and machines powered by hydraulic and pneumatic energy, and building working models of these.	
D. ELECTRICAL POWER TRANSMISSION The student should be able to: 1. identify the four units in the transmission cycle for electricity;	Review the definition of energy transmission. Show students by way of diagrams and audio-visual media the four units in the electrical transmission cycle from a cell and from a generating station.	UNITS IN THE ELECTRICAL TRANSMISSION CYCLE 1. Input 2. Control 3. Transmission 4. Output

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
2. recognize the importance of input, control, transmission, and output to the electrical energy transmission process;	Have students discuss the following diagrams and prepare posters, charts, displays, and illustrated reports explaining the importance of input, control, transmission, and output to the electrical energy transmission process.  TRANSMISSION OF ENERGY IN A SIMPLE CIRCUIT WITH A CONTROL DEVICE	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	 TRANSMISSION OF ELECTRICAL ENERGY FROM SOURCE TO USE	
3. compare the basic types of transmission paths;	Review the basic types of transmission paths. Demonstrate these concepts: a) Series circuits receive electricity from the same transmission path. b) Parallel circuits have many branches for electricity to follow. c) combination circuits have both series and parallel circuits. Have students view demonstrations and experiment to discover the limitations and benefits of each type of transmission path.	BASIC TYPES OF TRANSMISSION PATHS 1. Series circuit 2. Parallel circuit 3. Combination circuit Series Circuits, Parallel Circuits, Complex Circuits (colour filmstrips and cassettes), McIntyre Educational Media

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
4. describe the principles governing the application of direct current and alternating current to the transmission of electricity;	Review the definitions of direct and alternating current. Point out that in the transmission process, electrical current travels at the speed of light at the rate of 186 000 miles (299 274 kilometres) per second, or the equivalent of eight times around the world in one second. Demonstrate these principles of direct and alternating current applied to the transmission of electrical energy: a) Direct current, often called DC, flows only in one direction. b) Direct current moves from negative to positive. c) Batteries and cells produce direct current by chemical action. d) Generators produce direct current by mechanical action. e) Alternating current, often called AC, changes direction. f) Alternating current moves first in one direction and then in the other. g) The term frequency indicates how often alternating current changes direction. h) Alternating current changes direction 120 times per second, moving back and forth 60 times per second. i) Generators producing alternating current are called alternators. Have students report on the work of Thomas Edison to determine the principles and	Basic Electricity and Electronics: Direct Current, Basic Electricity and Electronics: Alternting Current (colour filmstrips, cassettes, study guides), McIntyre Educational Media Experiences With Electrons, South-Western Publishing, Part VI

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	applications of direct current, and the work of Nicholas Tesla and George Westinghouse to determine the principles and applications of alternating current.	
5. explain and demonstrate the uses of transformers, conductors, semiconductors, and insulators in the transmission of power and energy.	Review the uses of transformers, conductors, semiconductors, and insulators. Have students watch demonstrations, construct projects, and experiment to determine the functions and applications of transformers, conductors, semiconductors, and insulators in the power and energy transmission path.	
E. TRANSMISSION AND COMMUNICATIONS The student should be able to:		
1. identify the communication devices dependent upon electrical energy and electronic signals;	Hold brainstorming sessions about these concepts related to communication and communication devices: a) The human race has communicated in various ways for thousands of years. b) Communication dependent upon electrical energy and electronic signals has been possible only in the last century. c) Communication between people, people and machines, and machines and machines is possible through electronic means such as computers.	COMMUNICATION DEVICES Citizens band radios Electronic typewriters Facsimile machines Laser Microcomputers Microwave towers Radar systems Radios Satellites Telegraphs Telephones

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
		12. Televisions 13. Video disc players 14. Video display terminals 15. Video tape recorders
	Have students, individually or in groups, plan and prepare posters, collages, displays, and reports on various communication devices dependent on electrical energy and electronic signals.	
2. explain the communication/transmission process pertinent to communication devices;	Diagram and have students discuss this basic communication/transmission model:  Relate these steps in the communication/transmission process to various communication devices: a) An information source is the origin of the information to be communicated. b) The encoder or transmitter converts or changes the information to electrical/electronic signals.	Experiences With Electrons, South-Western Publishing, Part X, Units 1, 2, 3, 4, 5, 6, 7, 8

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	c) The information travels along some channel which may be electromagnetic waves, wires, air, or some other medium. d) The message is picked up by a decoder or receiver and converted to a form such as sound, picture, or print (electronic mail). e) The message reaches its destination, a person or a machine. f) The message may be interrupted by noise or another form of interference.	
3. describe the purposes and uses of frequencies in the communication/ transmission process;	Discuss the purposes of power, audio, and television frequencies pertaining to the various communication processes and devices. Make students aware that limited frequency locations are available, that they are assigned to satisfy the needs of many people for many purposes, that they are located to minimize interference between the various services, and that a frequency spectrum chart indicates the location of the various types of communication services. Have students learn frequencies by participating in some of these teaching/learning experiences: . using the frequency sprectrum chart to identify frequency locations of several communication services related to AM, FM,	Frequency spectrum chart

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	citizens band, and amateur radio, to television, to police, fire mobile, sea, and air communication devices, and to electric mail; . listing some of the frequencies used by radio stations; . identifying the frequencies used by local television stations; . considering when television frequencies are different from those of radio; . following operating instructions for walkie-talkie receivers (not requiring licenced operation) to determine the largest operating range and the effect of buildings, hills, and vehicles on operation; . building and using an FM minibroadcaster; . preparing scrapbooks and illustrated oral and written reports on radar communication/transmission systems, weather satellites, the use of laser for transmitting communications, and electronic mail.	
4. explain the relationship of the federal Department of Communication to communication transmission.	Point out the need to control the use of space in the transmission of communications. Explain that the federal Department of Communication and its related agencies promote the efficient growth of Canadian communications systems, helping them adjust to changing conditions, manage the frequency spectrum to permit orderly use	Canada Year Book, Statistics Canada

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
	of communications, issuing licences for various types of communiation systems, and protect Canadian interests in international telecommunications matters.	
	Have students collect information about how to apply for a licence to establish a new radio or television station. Invite a guest speaker from a radio or television station to explain the licencing procedures and the operating regulations related to the station.	

XI. POWER SYSTEMS (C.)

Estimated Time: 15 hours

MAJOR OBJECTIVE: To gain an understanding of various types and uses of power systems and to maintain and repair power systems.

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
A. INTRODUCTION TO POWER SYSTEMS The student should be able to: 1. define power system; 2. describe the parts of a power system.	Have students discuss and define the term power system. Discuss and give examples and illustrations of parts of a power system. Have students research this topic, defining and explaining the function of each part of a power system.	POWER SYSTEMS: A combination of parts that produces a needed output PARTS OF A POWER SYSTEM 1. Input of power 2. Transmission methods 3. Control devices 4. Output of usable power Introduction to Power Systems, Benziger Bruce and Glencoe Power: Mechanics and Energy Control, McKnight Publishing

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
B. TYPES OF POWER SYSTEMS The student should be able to:		
1. identify various types of power systems;	Show students illustrations and examples of various types of power systems and have them list power systems used on farms and in homes, schools, automobiles, motorycycles, radios, televisions, and microcomputers.	TYPES OF POWER SYSTEMS 1. Internal combustion engines 2. Automotive power systems 3. Tractor power systems 4. Household power systems 5. Farm power systems 6. Direct current/alternating current power supply system
2. develop an understanding of various types of power systems.	Have students discuss and participate in individual and group activities, such as preparing posters, charts, displays, illustrated written reports, and projects on various types of power systems for these purposes: . identification and comparison of input, transmission, control, and output; . recognition of similarities and differences; . identification of components and their functions; . demonstration of the use of electricity/electronics, pneumatics, and hydraulics, . identification of various types of circuits; . demonstration of operation.	

TOPICS AND OBJECTIVES	SUGGESTED ACTIVITIES AND NOTES	RESOURCES
C. MAINTENANCE AND REPAIR OF POWER SYSTEMS The student should be able to:		
1. define trouble-shooting;	Have students discuss and define trouble-shooting.	TROUBLESHOOTING: The process of determining why a device, circuit, or power system is not working as it should
2. develop an understanding of skills related to troubleshooting;	Emphasize the relationship of these skills to troubleshooting: . identification of defects and procedures for operating test instruments; . identification of tools and materials requisite for repairing defects; . recognition of the symptoms of defective devices, circuits, and systems; . development of plans to repair defective devices, circuits, and systems.	Troubleshooting Techniques (colour filmstrip, cassette, study guide), McIntyre Educational Media Understanding Electricity and Electronics, 4th ed., McGraw-Hill, Unit 48
3. diagnose problems in power systems;	Demonstrate the procedures for diagnosing problems in power systems, and have students follow these. Provide them with opportunities to locate and explain minor problems.	Experiences With Electrons, South-Western Publishing, Part IV (Projects) Introduction to Power Systems, Benziger Bruce and Glencoe
4. maintain and repair power systems.	Have students relate their diagnoses of problems to maintenance and repair of power systems.	

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Larson, Milton E. Teaching Related Subjects in Trade and Industrial and Technical Education. Columbus, OH: Charles E. Merrill Publishing, 1972.

Leighbody, Gerald B., and Donald M. Kidd. Methods of Teaching Shop and Technical Subjects. Albany, NY: Delmar Publishers, 1966.

Lindbeck, John R. Practical Guide to Industrial Arts Education. New York, NY: The Center for Applied Research in Education, 1972.

Maley, Donald A. The Industrial Arts Teacher's Handbook: Techniques, Principles, and Methods. Boston, MA: Allyn and Bacon, 1978.

Modern School Shop Planning. Ann Arbor, MI: Prakken Publications, 1971.

Organization and Administration Forms for Industrial Arts. Series 1000. Kennedy, MN: Instructional Materials Services, n.d.

Roberts, Roy W. Vocational and Practical Arts Education. New York, NY: Harper and Row Publishers, 1971.

Sarkees, Michelle Donnelly et al. Vocational Special Needs: Preparing TE and I Teachers. Alsip, IL: American Technical Publications, 1982.

Silvius, G. Harold, and Estell H. Curry. Managing Multiple Activities in Industrial Education. Bloomington, IL: McKnight Publishing Company, 1971.

Teaching Handicapped Students Vocational Education. Ed. Mary Jane Palomaki. Reston, VA: National Education Association, 1981.

Wilber, Gordon O., and Norman C. Penered. Industrial Arts in General Education, 4th ed. New York, NY: Intext Educational Publishers, 1973.

PERIODICALS

Canadian Vocational Journal. Canadian Vocational Association, Suite 608, 251 Bank Street, Ottawa, ON K2P 1X3 (quarterly).

Careers. Reed Career Service, Suite 800, 4445 Calgary Trail South, Edmonton, AB T6H 5C3.

Industrial Education. Harcourt Brace Jovanovich, 757 Third Avenue, New York, NY 10017 (monthly).

Man/Society/Technology. (Formerly Journal of Industrial Arts Education.) American Industrial Arts Association, 1914 Association Drive, Reston, VA 22091 (monthly).

National Safety News. National Safety Council, 444 N. Michigan Avenue, Chicago, IL 60611.

School Shop. Prakken Publications, 416 Longshore Drive, P. O. Box 8623, Ann Arbor, MI 48107 (monthly).

VocEd. (Formerly American Vocational Journal.) American Vocational Association, 2020 N. 14th Street, Arlington, VA 22201 (monthly).

MANITOBA LAW STATUTES

The Workers' Compensation Act, Manitoba Law Statutes, 1876-1979.

The Workplace Safety and Health Act, Manitoba Law Statutes, 1977-1978.

AUDIO-VISUAL MATERIALS

The following audio-visual materials, published by DCA Educational Products, Warrington, PA 18976, are available from Administration Information Media (AIM) Educational Aids, P. O. Box 86704, North Vancouver, British Columbia V7L 4L2.

1. Colour Transparencies, Overlays, Instructor's Guide

   a) Electrical Wiring-Residential
      - Bedroom #2 (EWR-1)
      - Bedroom #1 (EWR-2)
      - Bathroom and Passage (EWR-3)
      - Hall and Front Entrance (EWR-4)
      - Kitchen, Rear Entry (EWR-5)
      - Kitchen, Receptacle (EWR-6)
      - Living Room (EWR-7)
      - Dining Area, Porch, Rear Yard, Garage, Storage, Attic (EWR-8)
      - Garage (EWR-9)
      - Terrace, Recreation Room (EWR-10)
      - Utility Room (EWR-11)
      - Utility Room Receptacles (EWR-12)
      - Workshop, Laundry, Storage Room (EWR-13)
      - Remote Control System (EWR-14)

2. Filmstrips

   a) House Wiring
      - Basic Electrician's Tools (Unit 1)
      - Identifying Electrical Fittings (Unit 1)
      - Installing a Panel (Unit 1)
      - Installing Wall Receptacle Boxes (Unit 2)
      - Installing Switch Boxes (Unit 2)
      - Installing Ceiling Outlets (Unit 2)
      - Making a Temporary Entrance (Unit 3)
      - Installing Receptacles and Switches (Unit 3)
      - Wiring a 3-Way Switch (Unit 3)

   b) Electrical Wiring
      - Electrical Connections and Current Control (Unit 1)
      - Wiring Materials and Methods-1 (Unit 2)
      - Wiring Materials and Methods-2 (Unit 3)
      - Electrical Circuit Installation (Unit 4)

   c) Electricity/Electronics/Energy
      - Electronic Multimeters: Function and Use (9401)
      - Electronics: Schematic Symbols (9402)
      - Electronics: Vocabulary (9403)
      - Soldering: Introduction and Vocabulary (9550)
      - Margin of Acceptability (9551)
      - Printed Circuit (9552)
      - Wire Joints and Terminals (9553)

3. Pictotexts (Booklets) or Pictostrips (Filmstrips and Tapes)

   a) Electricity
      - Checking on Electrical Circuit
      - Cutting an Outlet Box Opening
      - Installing a Romex Cable
      - Installing an Outlet Box
      - Installing a Light Fixture
      - Replacing a Single-Pole Switch
      - Replacing a Duplex Receptacle
      - Installing a Dimmer Switch
      - Installing a GFI Receptacle
      - Installing a Grounded Plug

The following audio-visual materials are available from the Library, Manitoba Department of Education, 1181 Portage Avenue, Winnipeg, MB R3G 0T3.

1. Films - 16 mm Colour

- Electromagnets and Their Uses
- Electromagnets - How They Work
- Energy a Matter of Choices
- Energy and Matter
- Energy Dilemma
- Energy for the Future
- Energy from the Sun
- Energy Management for the Future
- Energy Seekers
- Energy: The Fuels and Man
- Energy: The Problems and the Future
- Standard Measurement
- Wind
- AC Parallel Circuits
- AC Series Circuits
- Basic Radio Circuitry
- Basic Wiring
- Capitance in AC Circuits
- Circuit Testing: Signal Generators
- Electrical Sources
- Electronics
- Fundamentals of AC and DC Generation
- Inductance in AC Circuits
- Learning About Electric Current
- The Principle of the Generator: Electro-Magnetic Induction
- Why Communications Satellites

2. Kits

- Aircraft Mechanic
- Architectural Drafting
- Career of an Automechanic
- A Career in Cabinet Making
- Careers in Graphic Arts
- Silkscreening
- The Electrician Kit
- The Machinist in the Plastic Moulding Industry
- Sheet Metal Working is . . .
- Critical Issues in Science and Society
- The Great Energy Debate Parts I and II
- Energy-Crisis and Resolution
- The Solar Quest
- Energy
- Energy Management for the Future

3. Videorecordings (Career Awareness Resource Library)

- Carpentry B-2
- Chemical and Plastics Processing F-1
- Concrete Finishing B-3
- Drafting O-4
- Electrical and Electronic Engineering A-8
- Electrical Power, Lighting, and Wire Communications B-4
- Electronic Products Manufacturing G-6
- General Manufacturing G-8
- Graphic Arts O-6
- Insulating and Roofing Occupations B-6
- Mechanics O-9
- Metal Machining G-11
- Metal Products F-4
- Metal Shaping and Forming G-12
- Photography D-5
- Photographic Processing O-13
- Plastering, Painting and Paper Hanging B-8
- Printing O-14
- Rubber and Plastic Products Manufacturing G-14
- Sheet Metalwork G-15
- Wood Processing F-2
- Wood Products Manufacturing G-19

4. Videorecordings and Viewer's Guide (Fast Forward Series)

- About Computers
- Business of Information
- Communications
- Electricity/Energy
- Global Television
- Humanized Technology (Series 1)
- Implications (Series 2)
- The Micro-electronic Revolution

The following audio-visual materials are available from the Film Library, Manitoba Hydro, P. O. Box 815, Winnipeg, Manitoba R3C 2P4.

1. Films - 16 mm Colour

- A Way of Life
- Accident Safe
- Don't Be Shocked
- Electrical Safety Around the Farm
- Electrical Safety from A to Zap
- Electrical Safety in Construction
- Electricity - Handle with Care
- Play It Safe Electrically
- The Generator and the Motor
- Project Transformer
- Manitoba Resources: Electricity
- Energy Realities
- The Nuclear Age
- Power from the Atom
- Progress in Power
- Nuclear Fuel Waste Management

The following audio-visual materials are available from McIntyre Educational Media, 30 Kelfield Street, Rexdale, ON M9W 5A2.

1. Colour Filmstrips, Cassettes, Study Guide

a) Energy Alternatives
- Solar - The Source
- Fossil Energy
- Nuclear Energy

b) Energy Alternatives II
- Renewable Energy
- Energy Conservation
- Energy Overview

c) Fusion Energy: Hope for the Future

d) Basic Electricity and Electronics: Direct Current
- The Electron Theory
- Circuits, Symbols, and Diagrams
- Meter Reading and Ohm's Law
- Series Circuits
- Parallel Circuits
- Resistor and Complex Circuits

e) Basic Electricity and Electronics: Alternating Current
- Alternating Current-What It Is and Where It's Used
- Alternating Current, Voltage, and Power
- Oscilloscopes and How To Use Them
- Oscilloscope Operation-Measuring Voltage
- Oscilloscope Operation-Determing Frequency

- Magnetism and Electromagnetism
- Inductors and Inductive Reactance
- Transformers
- Capacitors and Capacitive Resistance
- Inductors and Capacitors in AC Circuits

f) Electronic Power Supplies
- Troubleshooting Techniques

g) Electrical House Wiring Explained
- National Electrical Code Requirements
- Electrical Wiring Techniques
- Receptacles and Ground Fault Interruptors
- Switch Control
- Three-Way and Four-Way Switches
- Fuse and Circuit Breaker Panels

h) Residential Electrical Wiring: Planning and Roughing-In
- Estimating the Job
- Planning the Job
- Underground Service Entrance
- Roughing-In the Wiring
- Installing Recessed Fixtures

i) Residential Electrical Wiring: Finishing the Installation
- Installing Bathroom Ceiling Light and Exhaust Fan
- Special Purpose Outlets
- Small Appliance Circuits
- Oil Burner-Forced Hot Air Heating
- Hanging the Fixtures and Setting the Receptacles

j) Residential Electrical Wiring: Low Voltage and Special Circuits

- Installation for Signal Systems

- Installation for Telephone, TV
- Smoke and Fire Detectors
- Workshop Lighting and Receptacles
- Outdoor Lighting-Part One
- Outdoor Lighting-Part Two

The following audio-visual mterials, published by McKnight Publishing, Bloomington, IL, are distributed by Nelson Canada, 1120 Birchmount Road, Scarborough, ON M1K 5G4.

1. Colour Filmstrips, Cassettes, Guide

a) Electrical Connections and Current Control
- Electrical Connections
- Grounding
- Fuses, Circuit Breakers and GFCI's

b) Wiring Materials and Methods-1
- Nonmetallic Sheathed Cable
- Armored Cable
- Electrical Metallic Tubing

c) Wiring Materials and Methods-2
- Rigid Metal Conduit
- Flexible Metal Conduit
- PVC and Liquidtight Conduit

d) Electrical Circuit Installation
- Switching Circuits
- Special Switches and Switching Circuits
- Appliance and Heater Circuits

The following audio-visual materials are availabel from Prentice-Hall Media, 1870 Birchmount Road, Scarborough, ON M1P 2J7.

1. Colour Filmstrips, Cassettes, Guide

a) Safety
- On Guard!
- The Safety Program
- Practicing Safety
- Protecting Your Eyes
- Using Hand and Bench Tools
- Operating Power Machines
- Preparing for Emergencies
- Wounds, Sprains, Fractures
- Artificial Respiration

b) Electrical House Wiring
- Installing Electrical Power Service
- Installing and Wiring Outlet Boxes
- Running Wire
- The Doorbell: Installation and Trouble-shooting
- Electrical Safety: Systems and Procedures

c) Solving Basic DC Circuit Problems
- Introduction to DC Circuit Problems
- Simple Circuits and Networks: Ohm's Law
- Finding Resistance and Current by the Bridge Method: Kirchhoff's Laws
- Determining the Effects of Electrical Current

2. Colour Filmstrips, Cassettes, Guide, Reproducible Masters

a) Safety in Electrical Work
- Safety Guidelines
- Tool and Equipment Safety

3. Colour Film Loops - 8 mm

a) Electricity
- Electricity Produced by Friction
- Electricity Produced by Pressure, Heat, and Light
- Electricity Produced by Chemical Action - Part I
- Electricity Produced by Chemical Action - Part II
- Electricity Produced by Magnetism - Part I
- Electricity Produced by Magnetism - Part II
- Electromagnetism
- Conductors and Insulators
- Current Flow and Measurement
- Voltage and Voltage Measurement
- Resistance
- Resistance Measurement and Colour Code

b) Electronics
- Series Circuits - Part I: Current
- Series Circuits - Part II: Voltage
- Series Circuits - Part III: Resistance
- Parallel Circuits - Part I: Current
- Parallel Circuits - Part II: Voltage
- Parallel Circuits - Part III: Resistance
- Ohm's Law Theory - Part I
- Ohm's Law Theory - Part II
- Ohm's Law Formula: I = E ÷ R
- Ohm's Law Formula: E = I x R
- Ohm's Law Formula: R = E ÷ I
- The Diodes

4. Colour Film Loops - 8 mm, Instructor's Guide

a) Electrical House Wiring
- The Third Wire Can Save Your Life
- Rewiring a Lamp
- Wiring an Attachment Plug
- Troubleshooting a Bell Circuit
- Outlet Box Installation

- Wiring a Box with Armoured Cable
- Connecting Wires in an Outlet Box
- Installing a Convenience Outlet
- Toggle Switch Installation

The following audio-visual materials are available from Singer Career Systems, 80 Commerce Drive, Rochester, New York, NY 14623.

1. Colour Filmstrips, Cassettes, Summary Cards

a) Electrical
- Electric Wire and Cable
- Electrical Boxes
- Electrical Switches
- Installing Electrical Boxes and Cable
- Installing Electrical Boxes and Conduit
- Electrical Service Entrance
- Using a Fish Tape
- Circuit Breakers
- Understanding Solid State Components

b) Security
- How Alarm Systems Work
- Security Alarms and Devices

c) Electrical Maintenance
- Locating Defective Circuit Parts
- Reading Electric Meters
- Repairing Fluorescent Lights
- Replacing a Wall Switch
- Replacing a Light Fixture
- Replacing a Receptacle
- The Wire Stripper
- Replacing a Plug
- Replacing a Three-Way Switch

The following audio-vidual materials are available from American Association for Vocational Instruction Materials, 120 Driftmier Engineering Center, Athens, GA 30602:

1. Slides, Transparency Masters, Manual

a) Maintaining the Lighting and Wiring System
b) Understanding Electricity and Electrical Terms
c) Electrical Wiring Residential, Utility Buildings, Service Areas

Project kits and trainers are available from these suppliers:

1. Cam-Gard Supply, Electronic Division of General Distributors of Canada, 1777 Ellice Avenue, Winnipeg, MB R3H 0W5.

- Colour Organ Project
- Electric Engraver Project
- Electronic Siren Project
- Photoelectric Projects
- Shimmerlight Project
- Transformer Project

2. Graymark International, 5370-13th Avenue, Rosemount, PQ H1X 2X8.

- Battery Checker Project
- 500 Continuity Checker Project
- 6 and 9 Volt Power Supplies Project

3. Heathkit, 1315 Portage Avenue, Winnipeg, MB R3G 0V3.

4. Jana Electronics, 1777 Ellice Avenue, Winnipeg, MB R3H 0W5.

5. Lab Volt, 5370 13th Avenue, Rosemount, PQ H1X 2X8.

- Exploratory Electronics Laboratory Model 555
- Introduction to Electricity and Electronics Model 506

POWER MECHANICS AND POWER/ENERGY

TEXTBOOKS

Atkinson, H. Mechanics of Small Engines. SI metric. Scarborough, ON: McGraw-Hill Ryerson, 1978.

Bohn, Ralph C. et al. Power: Mechanics of Energy Control. Bloomington, IL: McKnight Publishing, 1983. (Distributed by Nelson Canada.)

Grannis, Gary E. Modern Power Mechanics. Indianapolis, IA: Bobbs-Merrill Educational Publishing, 1979. (Distributed by Copp Clark Pitman.)

Walker, John R. Exploring Power Technology Basic Fundamentals. South Holland, IL: Goodheart-Willcox, 1981. (Distributed by General Publishing.)

REFERENCE BOOKS

Braby, P. W. Electronics: A Practical Introduction. SI metric. Toronto, ON: Wiley and Sons, 1983.

Buban, Peter et al. Understanding Electricity/Electronics, 4th ed. New York, NY: McGraw-Hill, 1982.

Campbell, S. R. The Confident Consumer. South Holland, IL: Goodheart-Willcox, 1982. (Distributed by General Publishing.)

Canada Department of Manpower and Immigration. The Canadian Classification and Dictionary of Occupations. Ottawa, ON: The Department, 1971-1973.

----------. Careers Manitoba 1981, Volumes 1, 2, 3, 4. Ottawa, ON: The Department, 1981.

----------. Creating a Career. Instructor's Manual. Ottawa, ON: The Department, 1977.

----------. Creating a Career. Student's Book. Ottawa, ON: The Department, 1977.

----------. Training Manual for Canadian Classification and Dictionary of Occupations. Vol. 1. Ottawa, ON: The Department, 1972.

Canada Handbook. Ottawa, ON: Information Division, Statistics Canada, current year.

Canada Year Book. Ottawa, ON: Information Division, Statistics Canada, current year.

Drake, George R. Small Gasoline Engines: Maintenance, Troubleshooting, and Repair. Reston, VA: Reston Publishing, 1981.

Geil, John J. Energy and Transportation: Power. Englewood Cliffs, NJ: Prentice-Hall, 1976.

Manitoba Department of Education. Safety/Health Guide for Industrial Arts, Vocational, Home Economics, and Business Education. Curriculum Support Services. Winnipeg, MB: The Department, 1981.

----------. The Manitoba Career Guide. Winnipeg, MB: The Department, n.d.

Manitoba Trade Directory. Winnipeg, MB: Sanford Evans Publishing, 1982.

Matt, Stephen. Electricity and Basic Electronics. South Holland, IL: Goodheart-Willcox, 1977. (Distributed by General Publishing.)

Miller, Rex et al. Experiences With Electrons. Cincinnati, OH: South-Western Publishing, 1983. (Distributed by Gage Publishing.)

Miller, Wilbur R. et al. Power Mechanics. Bloomington, IL: McKnight Publishing, 1978. (Distributed by Nelson Canada.)

Murphy, Terry G. et al. The World of Business: A Canadian Profile. Toronto, ON: Wiley Publishers of Canada, 1978.

Ontario Federation of Labour. Occupational Health and Safety: A Training Manual. Toronto, ON: Copp Clark Pitman, 1982.

Roth, Alfred C. et al. Small Gas Engines. South Holland, IL: Goodheart-Willcox, 1978. (Distributed by General Publishing.)

Simes, Clifford E. Energy and Transportation: Automechanics. Englewood Cliffs, NJ: Prentice-Hall, 1976.

Suess, Alan et al. Introduction to Power Systems. Beverly Hills, CA: Benziger Bruce and Glencoe, 1976. (Distributed by Collier Macmillan Canada.)

The New Book of Knowledge, Volume 5, Grolier Incorporated.

The World Book Encyclopedia, Volume 6, World Book-Childcraft International.

Webster, Jay. The Basic Book of Power Mechanics. Chicago, IL: American Technical Society, 1979. (Distributed by Copp Clark Pitman.)

Wood, John C. Looking at the Consumer. Agincourt, ON: Gage Publishing, 1981.

Yadon, James N. Energy and Transportation: Small Engines. Englewood Cliffs, NJ: Prentice-Hall, 1976.

PROFESSIONAL BOOKS

Refer to Bibliography for Electricity/Electronics.

PERIODICALS

Refer to Bibliography for Electricity/Electronics.

AUDIO-VISUAL MATERIALS

The following audio-visual materials, published by DCA Educational Products, Warrington, PA 18976, are available from Administration Information Media (AIM) Educational Aids, P. O. Box 86704, North Vancouver, BC V7L 4L2.

1. Colour Transparencies, Overlays, Guide

a) The Fuel System - Group I
- Fuel Systems (AM-1)
- Carburetor Circuits (AM-2)
- Carburetor Circuits (AM-3)
- Carburetor Circuits (AM-4)
- The Mechanical Fuel Pump (AM-25)
- Carburetor Circuits (AM-45)

b) The Electrical System - Group II
- Ignition System
- Spark Plug
- The Ignition Distributor
- The Ignition Coil and Condenser
- A Standard Generator Assembly
- A Standard Starting Motor
- Generator and Conventional Ignition
- Alternator and Magnetic Pulse Ignition
- Battery Construction
- Battery Visual Checks
- Temperature Corrected Hydrometer
- Breaker Plate Installation

2. Filmstrips, Slide Sets, or Video Tapes

a) Electricity Electronics Energy
- Electronic Multimeters: Function and Use (9401)
- Electronics: Schematic Symbols

The following audio-visual materials are available from the Library, Manitoba Department of Education, 1181 Portage AVenue, Winnipeg, MB R3G OT3:

1. Films - 16 mm Colour

Refer to Bibliography for Electricity/Electronics.

2. Kits

Refer to Bibliography for Electricity/Electronics.

3. Videorecordings (Career Awareness Resource Library)

Refer to Bibliography for Electricity/Electronics.

4. Videorecordings and Viewer's Guide (Fast Forward Series)

Refer to Bibliography for Electricity/Electronics.

The following audio-visual materials are available from the Film Library, Manitoba Hydro, P. O. Box 815, Winnipeg, MB R3C 2P4.

1. Films - 16 mm Colour

Refer to Bibliography for Electricity/Electronics.

The following audio-visual materials are available from McIntyre Eduational Media, 30 Kelfield Street, Rexdale, ON M9W 5A2.

1. Colour Filmstrips, Cassettes, Guide

a) Small Engines Explained
- Basic Parts and Operations: Four-Stroke Cycle Engine

- Engine Disassembly
- Inspection and Valve Reconditioning
- Cylinder Reconditioning
- Engine Assembly
- Ignition System
- Fuel Systems
- Carburetor Service
- Routine Care and Maintenance

b) Basic Electricity and Electronics: Direct Curent
- The Electron Theory
- Circuits, Symbols, and Diagrams
- Meter Reading and Ohm's Law
- Series Circuits
- Parallel Circuits
- Resistor and Complex Circuits

c) Basic Electricity and Electronics: Alternating Current
- Alternating Curent-What It Is and Where It's Used
- Alternating Current, Voltage, and Power
- Oscilloscopes and How to Use Them
- Oscilloscopes Operation- Measuring Voltage
- Oscilloscopes Operation-Determining Frequency
- Magnetism and Electromagnetism
- Inductors and Inductive Reactance
- Transformers
- Capacitors and Capacitive Reactance
- Inductors and Capacitors in AC Circuits

d) Electronic Power Supplies
- Troubleshooting Techniques

The following audio-visual materials published by McKnight Publishing, Bloomington, IL, are distributed by Nelson Canada, 1120 Birchmount Road, Scarborough, ON M1K 5G4.

1. Colour Filmstrips, Cassettes

a) Small Engine Know-How
- Small Engine Systems - Set 1
- Basic Principles of Small Engines
- The Mechanical System
- Lubrication and Cooling

b) Fuel System: Ignition Troubleshooting - Set 2
- The Fuel System
- The Ignition System
- Troubleshooting the Small Engine

c) Routine Maintenance - Set 3
- Preventive Maintenance
- Tune-up Ignition
- Tune-up Fuel

d) Major Overhaul - Set 4
- Disassembly and Cleaning
- Inspection and Servicing
- Reassembly and Starting

The following audio-visual materials are available from Prentice-Hall Media, 1870 Birchmount Road, Scarborough, ON M1P 2J7.

1. Colour Filmstrips, Cassettes, Guides

a) Safety
- On Guard!

- The Safety Program
- Practicing Safety
- Protecting Your Eyes
- Using Hand and Bench Tools
- Operating Power Machines
- Preparing for Emergencies
- Wounds, Sprains, Fractures
- Artificial Respiration

b) Metrics for Auto Mechanics
- Wrench and Thread Sizes
- Metrics and the Car

c) Auto Mechanics Tools and Basic Skills
- Wrenches: Identification and Use
- Using Screw Drivers, Pliers and Hammers
- Working with Nuts and Bolts
- Working with Hoses
- Working with Steel and Copper Tubing
- Using Meters

d) The Basic Engine
- The Four-Stroke-Cycle Internal Combustion Engine
- Engine Components
- Valve Mechanisms and the Two-Stroke Cycle
- The Fuel System
- The Lubricating and Cooling Systems

e) Small Engine Service and Overhaul
- Seasonal Servicing: The Small Engine
- Ignition Service
- Fuel Service

f) Common Sense Car Care
- Spotting a Breakdown Before It Happens
- Survival Training for Road Breakdowns
- Good Miles Per Gallon Add Up to Real Dollars
- How to Buy, Sell or Trade a Car

g) How the Automobile Works
- The Electrical System
- The Cooling System
- The Ignition System

h) Basic Automotive Service
- Light Bulb Service
- Oil Change and Lubrication
- Repairing a Puncture in a Radial Tire
- Automobile Battery Service
- Electric Wiring Procedures

The following audio-visual materials are available from School Services of Canada, 66 Portland Street, Toronto, ON M5V 2M8.

1. Colour Filmstrips, Cassettes

a) Automotive
- The World of Automotive Technology (Part I)
- Automobile Shop Safety (Part II)

b) Small Engines
- The World of Small Engine Technology (Part I)
- Small Engine Shop Safety (Part II)